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A FREE

EXAMINATION

OF

DARWIN'S TREATISE ON THE ORIGIN OF SPECIES,

AND OF ITS

AMERICAN REVIEWERS.

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Reprinted from the ATLANTIC MONTHLY for July, August, and October, 1860.

LONDON:
TRÜBNER & CO., 60 PATERNOSTER ROW.
BOSTON: TICKNOR AND FIELDS.
1861.

UNIVERSITY PRESS:
PRINTED BY WELCH, BIGELOW, AND COMPANY,
CAMBRIDGE.

A FREE EXAMINATION

OF

DARWIN ON THE ORIGIN OF SPECIES.

ARTICLE I.

Novelties are enticing to most people: to us they are simply annoying. We cling to a long-accepted theory, just as we cling to an old suit of clothes. A new theory, like a new pair of breeches, (the Atlantic still affects the older type of nether garment,) is sure to have hard-fitting places; or even when no particular fault can be found with the article, it oppresses with a sense of general discomfort. New notions and new styles worry us, till we get well used to them, which is only by slow degrees.

Wherefore, in Galileo's time, we might have helped to proscribe, or to burn — had he been stubborn enough to warrant cremation — even the great pioneer of inductive research; although, when we had fairly recovered our composure, and had leisurely excogitated the matter, we might have come to conclude that the new doctrine was better than the old one, after all, at least for those who had nothing to unlearn.

Such being our habitual state of mind, it may well be believed that the perusal of the new book "On the Origin of Species by Means of Natural Selection" left an uncomfortable impression, in spite of its plausible and winning ways. We were not wholly unprepared for it, as many of our contemporaries seem to have been. The scientific reading in which we indulge as a relaxation from severer studies had raised dim forebodings. Investigations about the succession of species in time, and their actual geographical distribution over the earth's surface, were leading up from all sides and in various ways to the question of their origin. Now and then we encountered a sentence, like Professor Owen's "axiom of the continuous operation of the ordained becoming of living things," which haunted us like an apparition. For, dim as our conception must

needs be as to what such oracular and grandiloquent phrases might really mean, we felt confident that they presaged no good to old beliefs. Foreseeing, yet deprecating, the coming time of trouble, we still hoped that, with some repairs and make-shifts, the old views might last out our days. *Après nous le déluge.* Still, not to lag behind the rest of the world, we read the book in which the new theory is promulgated. We took it up, like our neighbors, and, as was natural, in a somewhat captious frame of mind.

Well, we found no cause of quarrel with the first chapter. Here the author takes us directly to the barn-yard and the kitchen-garden. Like an honorable rural member of our General Court, who sat silent until, near the close of a long session, a bill requiring all swine at large to wear pokes was introduced, when he claimed the privilege of addressing the house, on the proper ground that he had been "brought up among the pigs, and knew all about them," — so we were brought up among cows and cabbages; and the lowing of cattle, the cackling of hens, and the cooing of pigeons were sounds native and pleasant to our ears. So "Variation under Domestication" dealt with familiar subjects in a natural way, and gently introduced "Variation under Nature," which seemed likely enough. Then follows "Struggle for Existence," — a principle which we experimentally know to be true and cogent, — bringing the comfortable assurance, that man, even upon Leviathan Hobbes's theory of society, is no worse than the rest of creation, since all Nature is at war, one species with another, and the nearer kindred the more internecine, — bringing in thousand-fold confirmation and extension of the Malthusian doctrine, that population tends far to outrun means of subsistence throughout the animal and vegetable world, and has to be kept down by sharp preventive checks; so that not more than one of a hundred or a thousand of the individuals whose existence is so wonderfully and so sedulously provided for ever comes to anything, under ordinary circumstances; so the lucky and the strong must prevail, and the weaker and ill-favored must perish; — and then follows, as naturally as one sheep follows another, the chapter on "Natural Selection," Darwin's *cheval de bataille*, which is very much the Napoleonic doctrine, that Providence favors the strongest battalions, — that, since many more individuals are born than can possibly survive, those individuals and those variations which possess any advantage, however slight, over the rest, are in the long run sure to survive, to propagate, and to occupy the limited field, to the exclusion or destruction of the weaker brethren. All this we pondered, and could not much object to. In fact, we began to contract a liking for a system which at the outset illustrates the advantages of good breeding, and which makes the most "of every creature's best."

Could we "let by-gones be by-gones," and, beginning now, go on improving and diversifying for the future by natural selection, could we even take up the theory at the introduction of the actually existing species, we should be well content; and so, perhaps, would most naturalists be. It is by no means difficult to believe that varieties are incipient or possible species, when we see what trouble naturalists, especially botanists, have to distinguish between them, — one regarding as a true species what another regards as a variety; when the progress of knowledge continually increases, rather than diminishes, the number of doubtful instances; and when there is less agreement than ever among naturalists as to what is the basis in Nature upon which our idea of species reposes, or how the word is to be defined. Indeed, when we consider the endless disputes of naturalists and ethnologists over the human races, as to whether they belong to one species or to more, and if to more, whether to three, or five, or fifty, we can hardly help fancying that both may be right, — or rather, that the uni-humanitarians would have been right several thousand years ago, and the multi-humanitarians will be a few thousand years later; while at present the safe thing to say is, that probably there is some truth on both sides.

"Natural selection," Darwin remarks, "leads to divergence of character; for more living beings can be supported on the same area the more they diverge in structure, habits, and constitution," (a principle which, by the way, is paralleled and illustrated by the diversification of human labor,) and also leads to much extinction of intermediate or unimproved forms. Now, though this divergence may "steadily tend to increase," yet this is evidently a slow process in Nature, and liable to much counteraction wherever man does not interpose, and so not likely to work much harm for the future. And if natural selection, with artificial to help it, will produce better animals and better men than the present, and fit them better to "the conditions of existence," why, let it work, say we, to the top of its bent. There is still room enough for improvement. Only let us hope that it always works for good: if not, the divergent lines on Darwin's lithographic diagram of Transmutation made Easy, ominously show what small deviations from the straight path may come to in the end.

The prospect of the future, accordingly, is on the whole pleasant and encouraging. It is only the backward glance, the gaze up the long vista of the past, that reveals anything alarming. Here the lines converge as they recede into the geological ages, and point to conclusions which, upon the theory, are inevitable, but hardly welcome. The very first step backward makes the negro and the Hottentot our blood-relations; — not that reason or Scripture objects to that, though pride may. The next suggests a closer association of our ancestors of the

olden time with "our poor relations" of the quadrumanous family than we like to acknowledge. Fortunately, however, — even if we must account for him scientifically, — man with his two feet stands upon a foundation of his own. Intermediate links between the *Bimana* and the *Quadrumana* are lacking altogether; so that, put the genealogy of the brutes upon what footing you will, the four-handed races will not serve for our forerunners; — at least, not until some monkey, live or fossil, is producible with great-toes, instead of thumbs, upon his nether extremeties; or until some lucky geologist turns up the bones of his ancestor and prototype in France or England, who was so busy "napping the chuckie-stanes" and chipping out flint knives and arrow-heads in the time of the drift, very many ages ago, — before the British Channel existed, says Lyell,* — and until these men of the olden time are shown to have worn their great-toes in the divergent and thumb-like fashion. That would be evidence indeed: but until some testimony of the sort is produced, we must needs believe in the separate and special creation of man, however it may have been with the lower animals and with plants.

No doubt, the full development and symmetry of Darwin's hypothesis strongly suggest the evolution of the human no less than the lower animal races out of some simple primordial animal, — that all are equally "lineal descendants of some few beings which lived long before the first bed of the Silurian system was deposited." But, as the author speaks disrespectfully of spontaneous generation, and accepts a supernatural beginning of life on earth, in some form or forms of being which included potentially all that have since existed and are yet to be, he is thereby not warranted to extend his inferences beyond the evidence or the fair probability. There seems as great likelihood that one special origination should be followed by another upon fitting occasion, (such as the introduction of man,) as that one form should be transmuted into another upon fitting occasion, as, for instance, in the succession of species which differ from each other only in some details. To compare small things with great in a homely illustration: man alters from time to time his instruments or machines, as new circumstances or conditions may require and his wit suggest. Minor alterations and improvements he adds to the machine he possesses: he adapts a new rig or a new rudder to an old boat: this answers to *Variation*. "Like begets like," being the great rule in nature, if boats could engender, the variations would doubtless be propagated, like those of domestic cattle.

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* Vide *Proceedings of the British Association for the Advancement of Science*, 1859, and London *Athenæum*, passim. It appears to be conceded that these "celts" or stone knives are artificial productions, and apparently of the age of the mammoth, the fossil rhinoceros, etc.

In course of time the old ones would be worn out or wrecked; the best sorts would be chosen for each particular use, and further improved upon; and so the primordial boat be developed into the scow, the skiff, the sloop, and other species of water-craft, — the very diversification, as well as the successive improvements, entailing the disappearance of intermediate forms, less adapted to any one particular purpose; wherefore these go slowly out of use, and become extinct species: this is *Natural Selection.* Now let a great and important advance be made, like that of steam-navigation: here, though the engine might be added to the old vessel, yet the wiser and therefore the actual way is to make a new vessel on a modified plan: this may answer to *Specific Creation.* Anyhow, the one does not necessarily exclude the other. Variation and natural selection may play their part, and so may specific creation also. Why not?

This leads us to ask for the reasons which call for this new theory of transmutation. The beginning of things must needs lie in obscurity, beyond the bounds of proof, though within those of conjecture or of analogical inference. Why not hold fast to the customary view, that all spècies were directly, instead of indirectly, created after their respective kinds, as we now behold them, — and that in a manner which, passing our comprehension, we intuitively refer to the supernatural? Why this continual striving after "the unattained and dim"? why these anxious endeavors, especially of late years, by naturalists and philosophers of various schools and different tendencies, to penetrate what one of them calls "that mystery of mysteries," the origin of species?

To this, in general, sufficient answer may be found in the activity of the human intellect, "the delirious yet divine desire to know," stimulated as it has been by its own success, in unveiling the laws and processes of inorganic Nature, — in the fact that the principal triumphs of our age in physical science have consisted in tracing connections where none were known before, in reducing heterogeneous phenomena to a common cause or origin, in a manner quite analogous to that of the reduction of supposed independently originated species to a common ultimate origin, — thus, and in various other ways, largely and legitimately extending the domain of secondary causes. Surely the scientific mind of an age which contemplates the solar system as evolved from a common, revolving fluid mass, — which, through experimental research, has come to regard light, heat, electricity, magnetism, chemical affinity, and mechanical power as varieties or derivative and convertible forms of one force, instead of independent species, — which has brought the so-called elementary kinds of matter, such as the metals, into kindred groups, and pertinently raised the question, whether the members of each group may not be mere varieties of one species,

— and which speculates steadily in the direction of the ultimate unity of matter, of a sort of prototype or simple element which may be to the ordinary species of matter what the *Protozoa* or what the component cells of an organism are to the higher sorts of animals and plants, — the mind of such an age cannot be expected to let the old belief about species pass unquestioned. It will raise the question, how the diverse sorts of plants and animals came to be as they are and where they are, and will allow that the whole inquiry transcends its powers only when all endeavors have failed. Granting the origin to be supernatural, or miraculous even, will not arrest the inquiry. All real origination, the philosophers will say, is supernatural; their very question is, whether we have yet gone back to the origin, and can affirm that the present forms of plants and animals are the primordial, the miraculously created ones. And even if they admit that, they will still inquire into the order of the phenomena, into the form of the miracle. You might as well expect the child to grow up content with what it is told about the advent of its infant brother. Indeed, to learn that the newcomer is the gift of God, far from lulling inquiry, only stimulates speculation as to how the precious gift was bestowed. That questioning child is father to the man, — is philosopher in short clothes.

Since, then, questions about the origin of species will be raised, and have been raised, — and since the theorizings, however different in particulars, all proceed upon the notion that one species of plant or animal is somehow derived from another, that the different sorts which now flourish are lineal (or unlineal) descendants of other and earlier sorts, — it now concerns us to ask, What are the grounds in Nature, the admitted facts, which suggest hypotheses of derivation, in some shape or other? Reasons there must be, and plausible ones, for the persistent recurrence of theories upon this genetic basis. A study of Darwin's book, and a general glance at the present state of the natural sciences, enable us to gather the following as among the most suggestive and influential. We can only enumerate them here, without much indication of their particular bearing. There is, —

1. The general fact of variability, and the general tendency of the variety to propagate its like; — the patent facts, that all species vary more or less; that domesticated plants and animals, being in conditions favorable to the production and preservation of varieties, are apt to vary widely; and that by interbreeding, any variety may be fixed into a race, that is, into a variety which comes true from seed. Many such races, it is allowed, differ from each other in structure and appearance as widely as do many admitted species; and it is practically very difficult, even impossible, to draw a clear line between races and species. Witness the human races, for instance. Wild species also vary, per-

haps about as widely as those of domestication, though in different ways. Some of them appear to vary little, others moderately, others immoderately, to the great bewilderment of systematic botanists and zoölogists, and their increasing disagreement as to whether various forms shall be held to be original species or strong varieties. Moreover, the degree to which the descendants of the same stock, varying in different directions, may at length diverge, is unknown. All we know is, that varieties are themselves variable, and that very diverse forms have been educed from one stock.

2. Species of the same genus are not distinguished from each other by equal amounts of difference. There is diversity in this respect analogous to that of the varieties of a polymorphous species, some of them slight, others extreme. And in large genera the unequal resemblance shows itself in the clustering of the species around several types or central species, like satellites around their respective planets. Obviously suggestive this of the hypothesis that they were satellites, not thrown off by revolution, like the moons of Jupiter, Saturn, and our own solitary moon, but gradually and peacefully detached by divergent variation. That such closely related species may be only varieties of higher grade, earlier origin, or more favored evolution, is not a very violent supposition. Anyhow, it was a supposition sure to be made.

3. The actual geographical distribution of species upon the earth's surface tends to suggest the same notion. For, as a general thing, all or most of the species of a peculiar genus or other type are grouped in the same country, or occupy continuous, proximate, or accessible areas. So well does this rule hold, so general is the implication that kindred species are or were associated geographically, that most trustworthy naturalists, quite free from hypotheses of transmutation, are constantly inferring former geographical continuity between parts of the world now widely disjoined, in order to account thereby for certain generic similarities among their inhabitants, — just as philologists infer former connection of races, and a parent language, to account for generic similarities among existing languages. Yet no scientific explanation has been offered to account for the geographical association of kindred species, except the hypothesis of a common origin.

4. Here the fact of the antiquity of creation, and in particular of the present kinds of the earth's inhabitants, or of a large part of them, comes in to rebut the objection, that there has not been time enough for any marked diversification of living things through divergent variation, — not time enough for varieties to have diverged into what we call species.

So long as the existing species of plants and animals were thought to have originated a few thousand years ago, and without predecessors,

there was no room for a theory of derivation of one sort from another, nor time enough even to account for the establishment of the races which are generally believed to have diverged from a common stock. Not so much that five or six thousand years was a short allowance for this ; but because some of our familiar domesticated varieties of grain, of fowls, and of other animals, were pictured and mummified by the old Egyptians more than half that number of years ago, if not far earlier. Indeed, perhaps the strongest argument for the original plurality of human species was drawn from the identification of some of the present races of men upon these early historical monuments and records.

But this very extension of the current chronology, if we may rely upon the archæologists, removes the difficulty by opening up a longer vista. So does the discovery in Europe of remains and implements of pre-historic races of men, to whom the use of metals was unknown, — men of the *stone age*, as the Scandinavian archæologists designate them. And now, " axes and knives of flint, evidently wrought by human skill, are found in beds of the drift at Amiens, (also in other places, both in France and England,) associated with the bones of extinct species of animals." These implements, indeed, were noticed twenty years ago ; at a place in Suffolk they have been exhumed from time to time for more than a century ; but the full confirmation, the recognition of the age of the deposit in which the implements occur, their abundance, and the appreciation of their bearings upon most interesting questions, belong to the present time. To complete the connection of these primitive people with the fossil ages, the French geologists, we are told, have now " found these axes in Picardy associated with remains of *Elephas primigenius*, *Rhinoceros tichorhinus*, *Equus fossilis*, and an extinct species of *Bos*." * In plain language, these workers in flint lived in the time of the mammoth, of a rhinoceros now extinct, and along with horses and cattle unlike any now existing, — specifically different, as naturalists say, from those with which man is now associated. Their connection with existing human races may perhaps be traced through the intervening people of the stone age, who were succeeded by the people of the bronze age, and these by workers in iron.† Now, various evidence carries back the existence of many of the present lower species of animals, and probably of a larger number of plants, to the same drift period. All agree that this was very many thousand years ago. Agassiz tells us that the same species of polyps which are now building coral walls around the present peninsula of Florida actually made that peninsula, and have been building there for many thousand centuries.

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* See Correspondence of M. Nicklès, in *American Journal of Science and Arts*, for March, 1860.

† See Morlot, *Some General Views on Archæology*, in *American Journal of Science and Arts*, for January, 1860, translated from *Bulletin de la Société Vaudoise*, 1859.

5. The overlapping of existing and extinct species, and the seemingly gradual transition of the life of the drift period into that of the present, may be turned to the same account. Mammoths, mastodons, and Irish elks, now extinct, must have lived down to human, if not almost to historic times. Perhaps the last dodo did not long outlive his huge New Zealand kindred. The auroch, once the companion of mammoths, still survives, but owes his present and precarious existence to man's care. Now, nothing that we know of forbids the hypothesis that some new species have been independently and supernaturally created within the period which other species have survived. Some may even believe that man was created in the days of the mammoth, became extinct, and was recreated at a later date. But why not say the same of the auroch, contemporary both of the old man and of the new? Still it is more natural, if not inevitable, to infer, that, if the aurochs of that olden time were the ancestors of the aurochs of the Lithuanian forests, so likewise were the men of that age the ancestors of the present human races. Then, whoever concludes that these primitive makers of rude flint axes and knives were the ancestors of the better workmen of the succeeding stone age, and these again of the succeeding artificers in brass and iron, will also be likely to suppose that the *Equus* and *Bos* of that time, different though they be, were the remote progenitors of our own horses and cattle. In all candor we must at least concede that such considerations suggest a genetic descent from the drift period down to the present, and allow time enough — if time is of any account — for variation and natural selection to work out some appreciable results in the way of divergence into races, or even into so-called species. Whatever might have been thought, when geological time was supposed to be separated from the present era by a clear line, it is now certain that a gradual replacement of old forms by new ones is strongly suggestive of some mode of origination which may still be operative. When species, like individuals, were found to die out one by one, and apparently to come in one by one, a theory for what Owen sonorously calls "the continuous operation of the ordained becoming of living things" could not be far off.

That all such theories should take the form of a derivation of the new from the old seems to be inevitable, perhaps from our inability to conceive of any other line of secondary causes, in this connection. Owen himself is apparently in travail with some transmutation theory of his own conceiving, which may yet see the light, although Darwin's came first to the birth. Different as the two theories will probably be, they cannot fail to exhibit that fundamental resemblance in this respect which betokens a community of origin, a common foundation on the general facts and the obvious suggestions of modern science. Indeed,

— to turn the point of a pungent simile directed against Darwin, — the difference between the Darwinian and the Owenian hypotheses may, after all, be only that between homœopathic and heroic doses of the same drug.

If theories of derivation could only stop here, content with explaining the diversification and succession of species between the tertiary period and the present time, through natural agencies or secondary causes still in operation, we fancy they would not be generally or violently objected to by the *savans* of the present day. But it is hard, if not impossible, to find a stopping-place. Some of the facts or accepted conclusions already referred to, and several others, of a more general character, which must be taken into the account, impel the theory onward with accumulated force. *Vires* (not to say *virus*) *acquirit eundo.* The theory hitches on wonderfully well to Lyell's uniformitarian theory in geology, — that the thing that has been is the thing that is and shall be, — that the natural operations now going on will account for all geological changes in a quiet and easy way, only give them time enough, so connecting the present and the proximate with the farthest past by almost imperceptible gradations, — a view which finds large and increasing, if not general, acceptance in physical geology, and of which Darwin's theory is the natural complement.

So the Darwinian theory, once getting a foothold, marches boldly on, follows the supposed near ancestors of our present species farther and yet farther back into the dim past, and ends with an analogical inference which "makes the whole world kin." As we said at the beginning, this upshot discomposes us. Several features of the theory have an uncanny look. They may prove to be innocent: but their first aspect is suspicious, and high authorities pronounce the whole thing to be positively mischievous. In this dilemma we are going to take advice. Following the bent of our prejudices, and hoping to fortify these by new and strong arguments, we are going now to read the principal reviews which undertake to demolish the theory; — with what result our readers shall be duly informed.

Meanwhile, we call attention to the fact, that the Appletons have just brought out a second and revised American edition of Mr. Darwin's book, with numerous corrections, important additions, and a preface, all prepared by the author for this edition, in advance of a new English edition.

ARTICLE II.

"I can entertain no doubt, after the most deliberate study and dispassionate judgment of which I am capable, that the view which most naturalists entertain, and which I formerly entertained, — namely, that each species has been independently created, — is erroneous. I am fully convinced that species are not immutable; but that those belonging to what are called the same genera are lineal descendants of some other and generally extinct species, in the same manner as the acknowledged varieties of any one species are the descendants of that species. Furthermore, I am convinced that Natural Selection has been the main, but not exclusive, means of modification."

This is the kernel of the new theory, the Darwinian creed, as recited at the close of the introduction to the remarkable book under consideration. The questions, "What will he do with it?" and "How far will he carry it?" the author answers at the close of the volume: —

"I cannot doubt that the theory of descent with modification embraces all the members of the same class." Furthermore, "I believe that all animals have descended from at most only four or five progenitors, and plants from an equal or lesser number."

Seeing that analogy as strongly suggests a further step in the same direction, while he protests that "analogy may be a deceitful guide," yet he follows its inexorable leading to the inference that —

"Probably all the organic beings which have ever lived on this earth have descended from some one primordial form, into which life was first breathed."*

In the first extract we have the thin end of the wedge driven a little way; in the last, the wedge is driven home.

We have already sketched some of the reasons suggestive of such a theory of derivation of species, — reasons which give it plausibility, and even no small probability, as applied to our actual world and to changes occurring since the latest tertiary period. We are well pleased at this moment to find that the conclusions we were arriving at in this respect are sustained by the very high authority and impartial judgment of Pictet, the Swiss palæontologist. In his review of Darwin's book,† — the fairest and most admirable opposing one that has appeared, — he freely accepts that *ensemble* of natural operations which Darwin imper-

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* P. 484, Engl. ed. In the new American edition (*Vide* Supplement, pp. 431, 432) the principal analogies which suggest the extreme view are referred to, and the remark is appended, — "But this inference is chiefly grounded on analogy, and it is immaterial whether or not it be accepted. The case is different with the members of each great class, as the Vertebrata or Articulata; for here we have in the laws of homology, embryology, etc., some distinct evidence that all have descended from a single primordial parent."

† In *Bibliothèque Universelle de Genève*, Mars, 1860.

sonates under the now familiar name of Natural Selection, allows that the exposition throughout the first chapters seems "*à la fois prudent et fort*," and is disposed to accept the whole argument in its foundations, that is, so far as it relates to what is now going on, or has taken place in the present geological period, — which period he carries back through the diluvial epoch to the borders of the tertiary.* Pictet accordingly admits that the theory will very well account for the origination by divergence of nearly related species, whether within the present period or in remoter geological times: a very natural view for him to take; since he appears to have reached and published, several years ago, the pregnant conclusion, that there most probably was some material connection between the closely related species of two successive faunas, and that the numerous close species, whose limits are so difficult to determine, were not all created distinct and independent. But while thus accepting, or ready to accept, the basis of Darwin's theory, and all its legitimate direct inferences, he rejects the ultimate conclusions, brings some weighty arguments to bear against them, and is evidently convinced that he can draw a clear line between the sound inferences, which he favors, and the unsound or unwarranted theoretical deductions, which he rejects. We hope he can.

This raises the question, Why does Darwin press his theory to these extreme conclusions? Why do all hypotheses of derivation converge so inevitably to one ultimate point? Having already considered some of the reasons which suggest or support the theory at its outset, — which may carry it as far as such sound and experienced naturalists as Pictet allow that it may be true, — perhaps as far as Darwin himself unfolds it in the introductory proposition cited at the beginning of this article, — we may now inquire after the motives which impel the theorist so much farther. Here proofs, in the proper sense of the word, are not to be had. We are beyond the region of demonstration, and have only probabilities to consider. What are these probabilities? What work will this hypothesis do to establish a claim to be adopted in its completeness? Why should a theory which may plausibly enough account for the *diversification* of the species of each special type or genus, be expanded into a general system for the *origination* or successive diversification of all species, and all special types or forms, from four or five remote primordial forms, or perhaps from one? We accept the theory of gravitation because it explains all the facts we know, and bears all the tests that we can put it to. We incline to accept the

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* This we learn from his very interesting article, *De la Question de l'Homme Fossile*, in the same (March) number of the *Bibliothèque Universelle*. [See also, the same author's *Note sur la Periode Quaternaire ou Diluvienne, considérée dans ses Rapports avec l'Epoque Actuelle*, in the number for August, 1860, of the same periodical.]

nebular hypothesis, for similar reasons; not because it is proved, — thus far it is incapable of *proof*, — but because it is a natural theoretical deduction from accepted physical laws, is thoroughly congruous with the facts, and because its assumption serves to connect and harmonize these into one probable and consistent whole. Can the derivative hypothesis be maintained and carried out into a system on similar grounds? If so, however unproved, it would appear to be a tenable hypothesis, — which is all that its author ought now to claim. Such hypotheses as, from the conditions of the case, can neither be proved nor disproved by direct evidence or experiment, are to be tested only indirectly, and therefore imperfectly, by trying their power to harmonize the known facts, and to account for what is otherwise unaccountable. So the question comes to this: What will an hypothesis of the derivation of species explain which the opposing view leaves unexplained?

Questions these which ought to be entertained before we take up the arguments which have been advanced against this theory. We can barely glance at some of the considerations which Darwin adduces, or will be sure to adduce in the future and fuller exposition which is promised. To display them in such wise as to indoctrinate the unscientific reader would require a volume. Merely to refer to them in the most general terms would suffice for those familiar with scientific matters, but would scarcely enlighten those who are not. Wherefore let these trust the impartial Pictet, who freely admits, that, "in the absence of sufficient direct proofs to justify the possibility of his hypothesis, Mr. Darwin relies upon indirect proofs, the bearing of which is real and incontestable;" who concedes that "his theory accords very well with the great facts of comparative anatomy and zoölogy, — comes in admirably to explain unity of composition of organisms, also to explain rudimentary and representative organs, and the natural series of genera and species, — equally corresponds with many palæontological data, — agrees well with the specific resemblances which exist between two successive faunas, with the parallelism which is sometimes observed between the series of palæontological succession and of embryonal development," etc.; and finally, although he does not accept the theory in these results, he allows that "it appears to offer the best means of explaining the manner in which organized beings were produced in epochs anterior to our own."

What more than this could be said for such an hypothesis? Here, probably, is its charm, and its strong hold upon the speculative mind. Unproven though it be, and cumbered *prima facie* with cumulative improbabilities as it proceeds, yet it singularly accords with great classes of facts otherwise insulated and enigmatic, and explains many

things which are thus far utterly inexplicable upon any other scientific assumption.

We have said that Darwin's hypothesis is the natural complement to Lyell's uniformitarian theory in physical geology. It is for the organic world what that is for the inorganic; and the accepters of the latter stand in a position from which to regard the former in the most favorable light. Wherefore the rumor that the cautious Lyell himself has adopted the Darwinian hypothesis need not surprise us. The two views are made for each other, and, like the two counterpart pictures for the stereoscope, when brought together, combine into one apparently solid whole.

If we allow, with Pictet, that Darwin's theory will very well serve for all that concerns the present epoch of the world's history, — an epoch in which this renowned palæontologist includes the diluvial or quaternary period, — then Darwin's first and foremost need in his onward course is a practicable road from this into and through the tertiary period, the intervening region between the comparatively near and the far remote past. Here Lyell's doctrine paves the way, by showing that in the physical geology there is no general or absolute break between the two, probably no greater between the latest tertiary and the quaternary period than between the latter and the present time. So far, the Lyellian view is, we suppose, generally concurred in. It is largely admitted that numerous tertiary species have continued down into the quaternary, and many of them to the present time. A goodly percentage of the earlier and nearly half of the later tertiary mollusca, according to Des Hayes, Lyell, and, if we mistake not, Bronn, still live. This identification, however, is now questioned by a naturalist of the very highest authority. But, in its bearings on the new theory, the point here turns not upon absolute identity so much as upon close resemblance. For those who, with Agassiz, doubt the specific identity in any of these cases, and those who say, with Pictet, that "the later tertiary deposits contain in general the *débris* of species *very nearly related* to those which still exist, belonging to the same genera, but specifically different," may also agree with Pictet, that the nearly related species of successive faunas must or may have had "a material connection." But the only material connection that we have an idea of in such a case is a genealogical one. And the supposition of a genealogical connection is surely not unnatural in such cases, — is demonstrably the natural one as respects all those tertiary species which experienced naturalists have pronounced to be identical with existing ones, but which others now deem distinct. For to identify the two is the same thing as to conclude the one to be the ancestors of the other. No doubt there are differences between the tertiary and the present individuals,

differences equally noticed by both classes of naturalists, but differently estimated. By the one these are deemed quite compatible, by the other incompatible, with community of origin. *But who can tell us what amount of difference is compatible with community of origin?* This is the very question at issue, and one to be settled by observation alone. Who would have thought that the peach and the nectarine came from one stock? But, this being proved, is it now very improbable that both were derived from the almond, or from some common amygdaline progenitor? Who would have thought that the cabbage, cauliflower, broccoli, kale, and kohlrabi are derivatives of one species, and rape or colza, turnip, and probably rutabaga, of another species? And who that is convinced of this can long undoubtingly hold the original distinctness of turnips from cabbages as an article of faith? On scientific grounds may not a primordial cabbage or rape be assumed as the ancestor of all the cabbage races, on much the same ground that we assume a common ancestry for the diversified human races? If all our breeds of cattle came from one stock, why not this stock from the auroch, which has had all the time between the diluvial and the historic periods in which to set off a variation perhaps no greater than the difference between some sorts of domestic cattle?

That considerable differences are often discernible between tertiary individuals and their supposed descendants of the present day affords no argument against Darwin's theory, as has been rashly thought, but is decidedly in its favor. If the identification were so perfect that no more differences were observable between the tertiary and the recent shells than between various individuals of either, then Darwin's opponents, who argue the immutability of species from the ibises and cats preserved by the ancient Egyptians being just like those of the present day, could triumphantly add a few hundred thousand years more to the length of the experiment and to the force of their argument.

As the facts stand, it appears, that, while some tertiary forms are essentially undistinguishable from existing ones, others are the same with a difference, which is judged not to be specific or aboriginal; and yet others show somewhat greater differences, such as are scientifically expressed by calling them marked varieties, or else doubtful species; while others, differing a little more, are confidently termed distinct, but nearly related species. Now is not all this a question of degree, of mere gradation of difference? And is it at all likely that these several gradations came to be established in two totally different ways, — some of them (though naturalists can't agree which) through natural variation, or other secondary cause, and some by original creation, without secondary cause? We have seen that the judicious Pictet answers such questions as Darwin would have him do, in affirming, that, in all prob-

ability, the nearly related species of two successive faunas were materially connected, and that contemporaneous species, similarly resembling each other, were not all created so, but have become so. This is equivalent to saying that species (using the term as all naturalists do, and must continue to employ the word) have only a relative, not an absolute fixity ; that differences fully equivalent to what are held to be specific may arise in the course of time, so that one species may at length be naturally replaced by another species a good deal like it, or may be diversified into two, three, or more species, or forms as different as species. This concedes all that Darwin has a right to ask, all that he can directly infer from evidence. We must add that it affords a *locus standi*, more or less tenable, for inferring more.

Here another geological consideration comes in to help on this inference. The species of the later tertiary period for the most part not only resembled those of our days, — many of them so closely as to suggest an absolute continuity, — but also occupied in general the same regions that their relatives occupy now. The same may be said, though less specially, of the earlier tertiary and of the later secondary ; but there is less and less localization of forms as we recede, yet some localization even in palæozoic times. While in the secondary period one is struck with the similarity of forms and the identity of many of the species which flourished apparently at the same time in all or in the most widely separated parts of the world, in the tertiary epoch, on the contrary, along with the increasing specialization of climates and their approximation to the present state, we find abundant evidence of increasing localization of orders, genera, and species ; and this localization strikingly accords with the present geographical distribution of the same groups of species. Where the imputed forefathers lived, their relatives and supposed descendants now flourish. All the actual classes of the animal and vegetable kingdoms were represented in the tertiary faunas and floras, and in nearly the same proportions and the same diversities as at present. The faunas of what is now Europe, Asia, America, and Australia differed from each other much as they now differ : in fact, — according to Adolphe Brongniart, whose statements we here condense,* — the inhabitants of these different regions appear for the most part to have acquired, before the close of the tertiary period, the characters which essentially distinguish their existing faunas. The eastern continent had then, as now, its great pachyderms, elephants, rhinoceros, and hippopotamus ; South America, its armadillos, sloths, and ant-eaters ; Australia, a crowd of marsupials ; and the very strange birds of New Zealand had predecessors of similar strangeness.

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* In *Comptes Rendus, Acad. des Sciences*, Févr. 2, 1857.

Everywhere the same geographical distribution as now, with a difference in the particular area, as respects the northern portion of the continents, answering to a warmer climate then than ours, such as allowed species of hippopotamus, rhinoceros, and elephant to range even to the regions now inhabited by the reindeer and the musk-ox, and with the serious disturbing intervention of the glacial period within a comparatively recent time. Let it be noted, also, that those tertiary species which have continued with little change down to our days are the marine animals of the lower grades, especially mollusca. Their low organization, moderate sensibility, and the simple conditions of an existence in a medium like the ocean, not subject to great variation and incapable of sudden change, may well account for their continuance; while, on the other hand, the more intense, however gradual, climatic vicissitudes on land, which have driven all tropical and subtropical forms out of the higher latitudes and assigned to them their actual limits, would be almost sure to extinguish such huge and unwieldy animals as mastodons, mammoths, and the like, whose power of enduring altered circumstances must have been small.

This general replacement of the tertiary species of a country by others so much like them is a noteworthy fact. The hypothesis of the independent creation of all species, irrespective of their antecedents, leaves this fact just as mysterious as is creation itself; that of derivation undertakes to account for it. Whether it satisfactorily does so or not, it must be allowed that the facts well accord with that hypothesis.

The same may be said of another conclusion, namely, that the geological succession of animals and plants appears to correspond in a general way with their relative standing or rank in a natural system of classification. It seems clear, that, though no one of the *grand types* of the animal kingdom can be traced back farther than the rest, yet the lower *classes* long preceded the higher; that there has been on the whole a steady progression within each class and order; and that the highest plants and animals have appeared only in relatively modern times. It is only, however, in a broad sense that this generalization is now thought to hold good. It encounters many apparent exceptions, and sundry real ones. So far as the rule holds, all is as it should be upon an hypothesis of derivation.

The rule has its exceptions. But, curiously enough, the most striking class of exceptions, if such they be, seems to us even more favorable to the doctrine of derivation than is the general rule of a pure and simple ascending gradation. We refer to what Agassiz calls prophetic and synthetic types; for which the former name may suffice, as the difference between the two is evanescent.

"It has been noticed," writes our great zoölogist, "that certain types which are frequently prominent among the representatives of past ages, combine in their structure peculiarities which at later periods are only observed separately in different, distinct types. Sauroid fishes before reptiles, Pterodactyles before birds, Ichthyosauri before dolphins, etc. There are entire families, of nearly every class of animals, which in the state of their perfect development exemplify such prophetic relations. . . . The sauroid fishes of the past geological ages are an example of this kind. These fishes, which preceded the appearance of reptiles, present a combination of ichthyic and reptilian characters not to be found in the true members of this class, which form its bulk at present. The Pterodactyles, which preceded the class of birds, and the Ichthyosauri, which preceded the Cetacea, are other examples of such prophetic types." — Agassiz, *Contributions, Essay on Classification*, p. 117.

Now these reptile-like fishes, of which gar-pikes are the living representatives, though of earlier appearance, are admittedly of higher rank than common fishes. They dominated until reptiles appeared, when they mostly gave place to (or, as the derivationists will insist, were resolved by divergent variation and natural selection into) common fishes, destitute of reptilian characters, and saurian reptiles, — the intermediate grades, which, according to a familiar piscine saying, are "neither fish, flesh, nor good red-herring," being eliminated and extinguished by natural consequence of the struggle for existence which Darwin so aptly portrays. And so, perhaps, of the other prophetic types. Here type and antitype correspond. If these are true prophecies, we need not wonder that some who read them in Agassiz's book will read their fulfilment in Darwin's.

Note also, in this connection, that, along with a wonderful persistence of type, with change of species, genera, orders, etc., from formation to formation, no species and no higher group which has once unequivocally died out ever afterwards reappears. Why is this, but that the link of generation has been sundered? Why, on the hypothesis of independent originations, were not failing species recreated, either identically or with a difference, in regions eminently adapted to their well-being? To take a striking case. That no part of the world now offers more suitable conditions for wild horses and cattle than the Pampas and other plains of South America, is shown by the facility with which they have there run wild and enormously multiplied, since introduced from the Old World not long ago. There was no wild American stock. Yet in the times of the Mastodon and Megatherium, at the dawn of the present period, wild horses — certainly very much like the existing horse — roamed over those plains in abundance. On the principle of original and direct created adaptation of species to climate and other conditions, why were they not reproduced, when, after the colder intervening era, those regions became again eminently adapted to such animals? Why, but because, by their complete extinction in South America, the line of descent was there utterly broken? Upon the ordinary hypothesis, there

is no scientific explanation possible of this series of facts, and of many others like them. Upon the new hypothesis, "the succession of the same types of structure within the same areas during the later geological periods ceases to be mysterious, and is simply explained by inheritance." Their cessation is failure of issue.

Along with these considerations the fact (alluded to on p. 9) should be remembered, that, as a general thing, related species of the present age are geographically associated. The larger part of the plants, and still more of the animals, of each separate country are peculiar to it; and, as most species now flourish over the graves of their bygone relatives of former ages, so they now dwell among or accessibly near their kindred species.

Here also comes in that general "parallelism between the order of succession of animals and plants in geological times, and the gradation among their living representatives" from low to highly organized, from simple and general to complex and specialized forms; also "the parallelism between the order of succession of animals in geological times and the changes their living representatives undergo during their embryological growth," — as if the world were one prolonged gestation. Modern science has much insisted on this parallelism, and to a certain extent is allowed to have made it out. All these things, which conspire to prove that the ancient and the recent forms of life "are somehow intimately connected together in one grand system," equally conspire to suggest that the connection is one similar or analogous to generation. Surely no naturalist can be blamed for entering somewhat confidently upon a field of speculative inquiry which here opens so invitingly; nor need former premature endeavors and failures utterly dishearten him.

All these things, it may naturally be said, go to explain the order, not the mode, of the incoming of species. But they all do tend to bring out the generalization expressed by Mr. Wallace in the formula, that "every species has come into existence coincident both in time and space with pre-existing closely allied species." Not, however, that this is proved even of existing species as a matter of general fact. It is obviously impossible to *prove* anything of the kind. But we must concede that the known facts strongly suggest such an inference. And since species are only congeries of individuals, since every individual came into existence in consequence of pre-existing individuals of the same sort, so leading up to the individuals with which the species began, and since the only material sequence we know of among plants and animals is that from parent to progeny, the presumption becomes exceedingly strong that the connection of the incoming with the pre-existing species is a genealogical one.

Here, however, all depends upon the probability that Mr. Wallace's

inference is really true. Certainly it is not yet generally accepted; but a strong current is setting towards its acceptance.

So long as universal cataclysms were in vogue, and all life upon the earth was thought to have been suddenly destroyed and renewed many times in succession, such a view could not be thought of. So the equivalent view maintained by Agassiz, and formerly, we believe, by D'Orbigny, that, irrespectively of general and sudden catastrophes, or any known adequate physical cause, there has been a total depopulation at the close of each geological period or formation, say forty or fifty times or more, followed by as many independent great acts of creation, at which alone have species been originated, and at each of which a vegetable and an animal kingdom were produced entire and complete, full-fledged, as flourishing, as wide-spread and populous, as varied and mutually adapted from the beginning as ever afterwards, — such a view, of course, supersedes all material connection between successive species, and removes even the association and geographical range of species entirely out of the domain of physical causes and of natural science. This is the extreme opposite of Wallace's and Darwin's view, and is quite as hypothetical. The nearly universal opinion, if we rightly gather it, manifestly is, that the replacement of the species of successive formations was not complete and simultaneous, but partial and successive; and that along the course of each epoch some species probably were introduced, and some, doubtless, became extinct. If all since the tertiary belongs to our present epoch, this is certainly true of it: if to two or more epochs, then the hypothesis of a total change is not true of them.

Geology makes huge demands upon time; and we regret to find that it has exhausted ours, — that what we meant for the briefest and most general sketch of some geological considerations in favor of Darwin's hypothesis has so extended as to leave no room for considering "the great facts of comparative anatomy and zoölogy" with which Darwin's theory "very well accords," nor for indicating how "it admirably serves for explaining the unity of composition of all organisms, the existence of representative and rudimentary organs, and the natural series which genera and species compose." Suffice it to say that these are the real strongholds of the new system on its theoretical side; that it goes far towards explaining both the physiological and the structural gradations and relations between the two kingdoms, and the arrangement of all their forms in groups subordinate to groups, all within a few great types; that it reads the riddle of abortive organs and of morphological conformity, of which no other theory has ever offered a scientific explanation, and supplies a ground for harmonizing the two fundamental ideas which naturalists and philosophers conceive to have ruled the

organic world, though they could not reconcile them; namely, Adaptation to Purpose and to the Conditions of Existence, and Unity of Type. To reconcile these two undeniable principles is the capital problem in the philosophy of natural history; and the hypothesis which consistently does so thereby secures a great advantage.

We all know that the arm and hand of a monkey, the foreleg and foot of a dog and of a horse, the wing of a bat, and the fin of a porpoise are fundamentally identical; that the long neck of the giraffe has the same and no more bones than the short one of the elephant; that the eggs of Surinam frogs hatch into tadpoles with as good tails for swimming as any of their kindred, although as tadpoles they never enter the water; that the Guinea-pig is furnished with incisor teeth which it never uses, as it sheds them before birth; that embryos of mammals and birds have branchial slits and arteries running in loops, in imitation or reminiscence of the arrangement which is permanent in fishes; and that thousands of animals and plants have rudimentary organs which, at least in numerous cases, are wholly useless to their possessors, etc., etc. Upon a derivative theory this morphological conformity is explained by community of descent; and it has not been explained in any other way.

Naturalists are constantly speaking of "related species," of the "affinity" of a genus or other group, and of "family resemblance," — vaguely conscious that these terms of kinship are something more than mere metaphors, but unaware of the grounds of their aptness. Mr. Darwin assures them that they have been talking derivative doctrine all their lives — as M. Jourdain talked prose — without knowing it.

If it is difficult and in many cases practically impossible to fix the limits of species, it is still more so to fix those of genera; and those of tribes and families are still less susceptible of exact natural circumscription. Intermediate forms occur, connecting one group with another in a manner sadly perplexing to systematists, except to those who have ceased to expect absolute limitations in Nature. All this blending could hardly fail to suggest a former material connection among allied forms, such as that which an hypothesis of derivation demands.

Here it would not be amiss to consider the general principle of gradation throughout organic Nature, — a principle which answers in a general way to the Law of Continuity in the inorganic world, or rather is so analogous to it that both may fairly be expressed by the Leibnitzian axiom, *Natura non agit saltatim*. As an axiom or philosophical principle, used to test modal laws or hypotheses, this in strictness belongs only to physics. In the investigation of Nature at large, at least in the organic world, nobody would undertake to apply this principle as a test of the validity of any theory or supposed law. But

naturalists of enlarged views will not fail to infer the principle from the phenomena they investigate, — to perceive that the rule holds, under due qualifications and altered forms, throughout the realm of Nature; although we do not suppose that Nature in the organic world makes no distinct steps, but only short and serial steps, — not infinitely fine gradations, but no long leaps, or few of them.

To glance at a few illustrations out of many that present themselves. It would be thought that the distinction between the two organic kingdoms was broad and absolute. Plants and animals belong to two very different categories, fulfil opposite offices, and, as to the mass of them, are so unlike that the difficulty of the ordinary observer would be to find points of comparison. Without entering into details, which would fill an article, we may safely say that the difficulty with the naturalist is all the other way, — that all these broad differences vanish one by one as we approach the lower confines of the two kingdoms, and that no *absolute* distinction whatever is now known between them. It is quite possible that the same organism may be both vegetable and animal, or may be first the one and then the other. If some organisms may be said to be at first vegetables and then animals, others, like the spores and other reproductive bodies of many of the lower Algæ, may equally claim to have first a characteristically animal, and then an unequivocally vegetable existence. Nor is the gradation restricted to these simple organisms. It appears in general functions, as in that of reproduction, which is reducible to the same formula in both kingdoms, while it exhibits close approximations in the lower forms; also in a common or similar ground of sensibility in the lowest forms of both, a common faculty of effecting movements tending to a determinate end, traces of which pervade the vegetable kingdom, — while on the other hand, this indefinable principle, this vegetable

> Animula vagula, blandula,
> Hospes comesque corporis,

graduates into the higher sensitiveness of the lower class of animals. Nor need we hesitate to recognize the fine gradations from simple sensitiveness and volition to the higher instinctive and to the other psychical manifestations of the higher brute animals. The gradation is undoubted, however we may explain it.

Again, propagation is of one mode in the higher animals, of two in all plants; but vegetative propagation, by budding or offshoots, extends through the lower grades of animals. In both kingdoms there may be separation of the offshoots, or indifference in this respect, or continued and organic union with the parent stock; and this either with essential independence of the offshoots, or with a subordination of these to a common whole; or finally with such subordination and amalgamation,

along with specialization of function, that the same parts, which in other cases can be regarded only as progeny, in these become only members of an individual.

This leads to the question of individuality, a subject quite too large and too recondite for present discussion. The conclusion of the whole matter, however, is, that individuality — that very ground of *being* as distinguished from *thing* — is not attained in Nature at one leap. If anywhere truly exemplified in plants, it is only in the lowest and simplest, where the being is a structural unit, a single cell, memberless and organless, though organic, — the same thing as those cells of which all the more complex plants are built up, and with which every plant and (structurally) every animal began its development. In the ascending gradation of the vegetable kingdom individuality is, so to say, striven after, but never attained; in the lower animals it is striven after with greater, though incomplete success; it is realized only in animals of so high a rank that vegetative multiplication or offshoots are out of the question, where all parts are strictly members and nothing else, and all subordinated to a common nervous centre, — fully realized, perhaps, only in a conscious person.

So, also, the broad distinction between reproduction by seeds or ova and propagation by buds, though perfect in some of the lowest forms of life, becomes evanescent in others; and even the most absolute law we know in the physiology of genuine reproduction, that of sexual cooperation, has its exceptions in both kingdoms in parthenogenesis, to which in the vegetable kingdom a most curious and intimate series of gradations leads. In plants, likewise, a long and finely graduated series of transitions leads from bisexual to unisexual blossoms; and so in various other respects. Everywhere we may perceive that Nature secures her ends, and makes her distinctions on the whole manifest and real, but everywhere without abrupt breaks. We need not wonder, therefore, that gradations between species and varieties should occur; the more so, since genera, tribes, and other groups into which the naturalist collocates species are far from being always absolutely limited in Nature, though they are necessarily represented to be so in systems. From the necessity of the case, the classifications of the naturalist abruptly define where Nature more or less blends. Our systems are nothing, if not definite. They are intended to express differences, and perhaps some of the coarser gradations. But this evinces not their perfection, but their imperfection. Even the best of them are to the system of Nature what consecutive patches of the seven colors are to the rainbow.

Now the principle of gradation throughout organic Nature may, of course, be interpreted upon other assumptions than those of Darwin's

hypothesis, — certainly upon quite other than those of a materialistic philosophy, with which we ourselves have no sympathy. Still we conceive it not only possible, but probable, that this gradation, as it has its natural ground, may yet have its scientific explanation. In any case, there is no need to deny that the general facts correspond well with an hypothesis like Darwin's, which is built upon fine gradations.

We have contemplated quite long enough the general presumptions in favor of an hypothesis of the derivation of species. We cannot forget, however, while for the moment we overlook, the formidable difficulties which all hypotheses of this class have to encounter, and the serious implications which they seem to involve. We feel, moreover, that Darwin's particular hypothesis is exposed to some special objections. It requires no small strength of nerve steadily to conceive, not only of the diversification, but of the formation of the organs of an animal through cumulative variation and natural selection. Think of such an organ as the eye, that most perfect of optical instruments, as so produced in the lower animals and perfected in the higher! A friend of ours, who accepts the new doctrine, confesses that for a long while a cold chill came over him whenever he thought of the eye. He has at length got over that stage of the complaint, and is now in the fever of belief, perchance to be succeeded by the sweating stage, during which sundry peccant humors may be eliminated from the system.

For ourselves, we dread the chill, and have some misgiving about the consequences of the reaction. We find ourselves in the "singular position" acknowledged by Pictet, — that is, confronted with a theory which, although it can really explain much, seems inadequate to the heavy task it so boldly assumes, but which, nevertheless, appears better fitted than any other that has been broached to explain, if it be possible to explain, somewhat of the manner in which organized beings may have arisen and succeeded each other. In this dilemma we might take advantage of Mr. Darwin's candid admission, that he by no means expects to convince old and experienced people, whose minds are stocked with a multitude of facts all viewed during a long course of years from the old point of view. This is nearly our case. So, owning no call to a larger faith than is expected of us, but not prepared to pronounce the whole hypothesis untenable, under such construction as we should put upon it, we naturally sought to attain a settled conviction through a perusal of several proffered refutations of the theory. At least, this course seemed to offer the readiest way of bringing to a head the various objections to which the theory is exposed. On several accounts some of these opposed reviews specially invite examination. We propose, accordingly, to conclude our task with an article upon "Darwin and his Reviewers."

ARTICLE III.

The origin of species, like all origination, like the institution of any other natural state or order, is beyond our immediate ken. We see or may learn how things go on; we can only frame hypotheses as to how they began.

Two hypotheses divide the scientific world, very unequally, upon the origin of the existing diversity of the plants and animals which surround us. One assumes that the actual kinds are primordial; the other, that they are derivative. One, that all kinds originated supernaturally and directly as such, and have continued unchanged in the order of Nature; the other, that the present kinds appeared in some sort of genealogical connection with other and earlier kinds, that they became what they now are in the course of time and in the order of Nature.

Or, bringing in the word *Species*, which is well defined as "the perennial succession of individuals," commonly of very like individuals, — as a close corporation of individuals perpetuated by generation, instead of election, — and reducing the question to mathematical simplicity of statement: species are lines of individuals coming down from the past and running on to the future, lines receding, therefore, from our view in either direction. Within our limited observation they appear to be parallel lines, as a general thing neither approaching to nor diverging from each other.

The first hypothesis assumes that they were parallel from the unknown beginning and will be to the unknown end. The second hypothesis assumes that the apparent parallelism is not real and complete, at least aboriginally, but approximate or temporary; that we should find the lines convergent in the past, if we could trace them far enough; that some of them, if produced back, would fall into certain fragments of lines, which have left traces in the past, lying not exactly in the same direction, and these farther back into others to which they are equally unparallel. It will also claim that the present lines, whether on the whole really or only approximately parallel, sometimes fork or send off branches on one side or the other, producing new lines, (varieties,) which run for a while, and for aught we know indefinitely when not interfered with, near and approximately parallel to the parent line. This claim it can establish; and it may also show that these close subsidiary lines may branch or vary again, and that those branches or varieties which are best adapted to the existing conditions may be continued, while others stop or die out. And so we may have the basis of a real *theory* of the *diversification* of species; and here, indeed, there

is a real, though a narrow, established ground to build upon. But, as systems of organic Nature, both are equally *hypotheses*, are suppositions of what there is no proof of from experience, assumed in order to account for the observed phenomena, and supported by such indirect evidence as can be had.

Even when the upholders of the former and more popular system mix up revelation with scientific discussion, — which we decline to do, — they by no means thereby render their view other than hypothetical. Agreeing that plants and animals were produced by Omnipotent fiat does not exclude the idea of natural order and what we call secondary causes. The record of the fiat — "Let the earth bring forth grass, the herb yielding seed," etc., "and it was so"; "let the earth bring forth the living creature after his kind, cattle and creeping thing and beast of the earth after his kind, and it was so" — seems even to imply them. Agreeing that they were formed of "the dust of the ground," and of thin air, only leads to the conclusion that the pristine individuals were corporeally constituted like existing individuals, produced through natural agencies. To agree that they were created "after their kinds" determines nothing as to what were the original kinds, nor in what mode, during what time, and in what connections it pleased the Almighty to introduce the first individuals of each sort upon the earth. Scientifically considered, the two opposing doctrines are equally hypothetical.

The two views very unequally divide the scientific world; so that believers in "the divine right of majorities" need not hesitate which side to take, at least for the present. Up to a time within the memory of a generation still on the stage, two hypotheses about the nature of light very unequally divided the scientific world. But the small minority has already prevailed: the emission theory has gone out; the undulatory or wave theory, after some fluctuation, has reached high tide, and is now the pervading, the fully established system. There was an intervening time during which most physicists held their opinions in suspense.

The adoption of the undulatory theory of light called for the extension of the same theory to heat, and this promptly suggested the hypothesis of a correlation, material connection, and transmutability of heat, light, electricity, magnetism, etc.; which hypothesis the physicists held in absolute suspense until very lately, but are now generally adopting. If not already established as a system, it promises soon to become so. At least, it is generally received as a tenable and probably true hypothesis.

Parallel to this, however less cogent the reasons, Darwin and others, having shown it likely that some varieties of plants or animals have diverged in time into cognate species, or into forms as different as spe-

cies, are led to infer that all species of a genus may have thus diverged from a common stock, and thence to suppose a higher community of origin in ages still farther back, and so on. Following the safe example of the physicists, and acknowledging the fact of the diversification of a once homogeneous species into varieties, we may receive the theory of the evolution of these into species, even while for the present we hold the hypothesis of a further evolution in cool suspense or in grave suspicion. In respect to very many questions a wise man's mind rests long in a state neither of belief nor of unbelief. But your intellectually short-sighted people are apt to be preternaturally clear-sighted, and to find their way very plain to positive conclusions upon one side or the other of every mooted question.

In fact, most people, and some philosophers, refuse to hold questions in abeyance, however incompetent they may be to decide them. And, curiously enough, the more difficult, recondite, and perplexing the questions or hypotheses are, — such, for instance, as those about organic Nature, — the more impatient they are of suspense. Sometimes, and evidently in the present case, this impatience grows out of a fear that a new hypothesis may endanger cherished and most important beliefs. Impatience under such circumstances is not unnatural, though perhaps needless, and, if so, unwise.

To us the present revival of the derivative hypothesis, in a more winning shape than it ever before had, was not unexpected. We wonder that any thoughtful observer of the course of investigation and of speculation in science should not have foreseen it, and have learned at length to take its inevitable coming patiently; the more so, as in Darwin's treatise it comes in a purely scientific form, addressed only to scientific men. The notoriety and wide popular perusal of this treatise appear to have astonished the author even more than the book itself has astonished the reading world. Coming, as the new presentation does, from a naturalist of acknowledged character and ability, and marked by a conscientiousness and candor which have not always been reciprocated, we have thought it simply right to set forth the doctrine as fairly and as favorably as we could. There are plenty to decry it, and the whole theory is widely exposed to attack. For the arguments on the other side we may look to the numerous adverse publications which Darwin's volume has already called out, and especially to those reviews which propose directly to refute it. Taking various lines and reflecting very diverse modes of thought, these hostile critics may be expected to concentrate and enforce the principal objections which can be brought to bear against the derivative hypothesis in general, and Darwin's new exposition of it in particular.

Upon the opposing side of the question we have read with attention,

1. an article in the "North American Review" for April last; 2. one in the "Christian Examiner," Boston, for May; 3. M. Pictet's article in the "Bibliothèque Universelle," which we have already made considerable use of, which seems throughout most able and correct, and which in tone and fairness is admirably in contrast with, 4. the article in the "Edinburgh Review" for May, attributed — although against a large amount of internal presumptive evidence — to the most distinguished British comparative anatomist; 5. an article in the "North British Review" for May; 6. finally, Professor Agassiz has afforded an early opportunity to peruse the criticisms he makes in the forthcoming third volume of his great work, by a publication of them in advance in the "American Journal of Science" for July.

In our survey of the lively discussion which has been raised, it matters little how our own particular opinions may incline. But we may confess to an impression, thus far, that the doctrine of the permanent and complete immutability of species has not been established, and may fairly be doubted. We believe that species vary, and that "Natural Selection" works; but we suspect that its operation, like every analogous natural operation, may be limited by something else. Just as every species by its natural rate of reproduction would soon fill any country it could live in, but does not, being checked by some other species or some other condition, — so it may be surmised that Variation and Natural Selection have their Struggle and consequent Check, or are limited by something inherent in the constitution of organic beings.

We are disposed to rank the derivative hypothesis in its fulness with the nebular hypothesis, and to regard both as allowable, as not unlikely to prove tenable in spite of some strong objections, but as not therefore demonstrably true. Those, if any there be, who regard the derivative hypothesis as satisfactorily proved, must have loose notions as to what proof is. Those who imagine it can be easily refuted and cast aside must, we think, have imperfect or very prejudiced conceptions of the facts concerned and of the questions at issue.

We are not disposed nor prepared to take sides for or against the new hypothesis, and so, perhaps, occupy a good position from which to watch the discussion and criticise those objections which are seemingly inconclusive. On surveying the arguments urged by those who have undertaken to demolish the theory, we have been most impressed with a sense of their great inequality. Some strike us as excellent and perhaps unanswerable; some, as incongruous with other views of the same writers; others, when carried out, as incompatible with general experience or general beliefs, and therefore as proving too much; still others, as proving nothing at all: so that, on the whole, the effect is

rather confusing and disappointing. We certainly expected a stronger adverse case than any which the thorough-going opposers of Darwin appear to have made out. Wherefore, if it be found that the new hypothesis has grown upon our favor as we proceeded, this must be attributed not so much to the force of the arguments of the book itself as to the want of force of several of those by which it has been assailed. Darwin's arguments we might resist or adjourn ; but some of the refutations of it give us more concern than the book itself did.

These remarks apply mainly to the philosophical and theological objections which have been elaborately urged, almost exclusively by the American reviewers. The "North British" reviewer, indeed, roundly denounces the book as atheistical, but evidently deems the case too clear for argument. The Edinburgh reviewer, on the contrary, scouts all such objections, — as well he may, since he records his belief in "a continuous creative operation," "a constantly operating secondary creational law," through which species are successively produced ; and he emits faint, but not indistinct, glimmerings of a transmutation theory of his own ;* so that he is equally exposed to all the philosophical objections advanced by Agassiz, and to most of those urged by the other American critics, against Darwin himself.

Proposing now to criticise the critics, so far as to see what their most general and comprehensive objections amount to, we must needs begin with the American reviewers, and with their arguments adduced to prove that a derivative hypothesis *ought not to be true*, or is not possible, philosophical, or theistic.

It must not be forgotten that on former occasions very confident judgments have been pronounced by very competent persons, which have not been finally ratified. Of the two great minds of the seventeenth century, Newton and Leibnitz, both profoundly religious as well as philosophical, one produced the theory of gravitation, the other objected to that theory that it was subversive of natural religion. The nebular hypothesis — a natural consequence of the theory of gravitation and of the subsequent progress of physical and astronomical discovery — has been denounced as atheistical even down to our own day. But it is now largely adopted by the most theistical natural philosophers as a tenable and perhaps sufficient hypothesis, and where not

* Whatever it may be, it is not "the homœopathic form of the transmutative hypothesis," as Darwin's is said to be, (p. 252, Amer. reprint,) so happily that the prescription is repeated in the second (p. 259) and third (p. 271) dilutions, no doubt, on Hahnemann's famous principle, with an increase of potency at each dilution. Probably the supposed transmutation is *per saltus*. "Homœopathic doses of transmutation," indeed ! Well, if we really must swallow transmutation in some form or other, as this reviewer intimates, we might prefer the mild homœopathic doses of Darwin's formula to the allopathic bolus which the Edinburgh general practitioner appears to be compounding.

accepted is no longer objected to, so far as we know, on philosophical or religious grounds.

The gist of the philosophical objections urged by the two Boston reviewers against an hypothesis of the derivation of species — or at least against Darwin's particular hypothesis — is, that it is incompatible with the idea of any manifestation of design in the universe, that it denies final causes. A serious objection this, and one that demands very serious attention.

The proposition, that things and events in Nature were not designed to be so, if logically carried out, is doubtless tantamount to atheism. Yet most people believe that some were designed and others were not, although they fall into a hopeless maze whenever they undertake to define their position. So we should not like to stigmatize as atheistically disposed a person who regards certain things and events as being what they are through designed laws, (whatever that expression means,) but as not themselves specially ordained, or who, in another connection, believes in general, but not in particular Providence. We could sadly puzzle him with questions; but in return he might equally puzzle us. Then, to deny that anything was specially designed to be what it is, is one proposition; while to deny that the Designer supernaturally or immediately made it so, is another: though the reviewers appear not to recognize the distinction.

Also, "scornfully to repudiate" or to "sneer at the idea of any manifestation of design in the material universe," * is one thing; while to consider, and perhaps to exaggerate, the difficulties which attend the practical application of the doctrine of final causes to certain instances, is quite another thing: yet the Boston reviewers, we regret to say, have not been duly regardful of the difference. Whatever be thought of Darwin's doctrine, we are surprised that he should be charged with *scorning* or *sneering* at the opinions of others, upon such a subject. Perhaps Darwin's view is incompatible with final causes; — we will consider that question presently; — but as to the "Examiner's" charge, that he "sneers at the idea of any manifestation of design in the material universe," though we are confident that no misrepresentation was intended, we are equally confident that it is not at all warranted by the two passages cited in support of it. Here are the passages: —

"If green woodpeckers alone had existed, or we did not know that there were many black and pied kinds, I dare say that we should have thought that the green color was a beautiful adaptation to hide this tree-frequenting bird from its enemies."

"If our reason leads us to admire with enthusiasm a multitude of inimitable contrivances in Nature, this same reason tells us, though we may easily err on both

* Vide *North American Review*, for April, 1860, p. 475, and *Christian Examiner*, for May, p. 457.

sides, that some contrivances are less perfect. Can we consider the sting of the wasp or of the bee as perfect, which, when used against many attacking animals, cannot be withdrawn, owing to the backward serratures, and so inevitably causes the death of the insect by tearing out its viscera?"

If the sneer here escapes ordinary vision in the detached extracts (one of them wanting the end of the sentence), it is, if possible, more imperceptible when read with the context. Moreover, this perusal inclines us to think that the "Examiner" has misapprehended the particular argument or object, as well as the spirit, of the author in these passages. The whole reads more naturally as a caution against the inconsiderate use of final causes in science, and an illustration of some of the manifold errors and absurdities which their hasty assumption is apt to involve, — considerations probably equivalent to those which induced Lord Bacon rather disrespectfully to style final causes "sterile virgins." So, if any one, it is here Bacon that "sitteth in the seat of the scornful." As to Darwin, in the section from which the extracts were made, he is considering a subsidiary question, and trying to obviate a particular difficulty, but, we suppose, is wholly unconscious of denying "any manifestation of design in the material universe." He concludes the first sentence: —

—— "and consequently that it was a character of importance, and might have been acquired through natural selection; as it is, I have no doubt that the color is due to some quite distinct cause, probably to sexual selection."

After an illustration from the vegetable creation, Darwin adds: —

"The naked skin on the head of a vulture is generally looked at as a *direct* adaptation for wallowing in putridity; *and so it may be*, or it may possibly be due to the direct action of putrid matter; but we should be very cautious in drawing any such inference, when we see that the skin on the head of the clean-feeding male turkey is likewise naked. The sutures in the skulls of young mammals have been advanced as a beautiful adaptation for aiding parturition, and no doubt they facilitate or may be indispensable for this act; but as sutures occur in the skulls of young birds and reptiles, which have only to escape from a broken egg, we may infer that this structure has arisen from the laws of growth, and has been taken advantage of in the parturition of the higher animals."

All this, simply taken, is beyond cavil, unless the attempt to explain scientifically how any designed result is accomplished savors of impropriety.

In the other place, Darwin is contemplating the patent fact, that "perfection here below" is relative, not absolute, — and illustrating this by the circumstance, that European animals, and especially plants, are now proving to be better adapted for New Zealand than many of the indigenous ones, — that "the correction for the aberration of light is said, on high authority, not to be quite perfect even in that most perfect organ, the eye." And then follows the second extract of the reviewer.

But what is the position of the reviewer upon his own interpretation of these passages? If he insists that green woodpeckers were specifically created so in order that they might be less liable to capture, must he not equally hold that the black and pied ones were specifically made of these colors in order that they might be more liable to be caught? And would an explanation of the mode in which those woodpeckers came to be green, however complete, convince him that the color was undesigned?

As to the other illustration, is the reviewer so complete an optimist as to insist that the arrangement and the weapon are wholly perfect (*quoad* the insect) the normal use of which often causes the animal fatally to injure or to disembowel itself? Either way it seems to us that the argument here, as well as the insect, performs *hari-kari*.

The "Examiner" adds: —

"We should in like manner object to the word *favorable*, as implying that some species are placed by the Creator under *unfavorable* circumstances, at least under such as might be advantageously modified."

But are not many individuals and some races of men placed by the Creator "under unfavorable circumstances, at least under such as might be advantageously modified"? Surely these reviewers must be living in an ideal world, surrounded by "the faultless monsters which *our* world ne'er saw," in some elysium where imperfection and distress were never heard of! Such arguments resemble some which we often hear against the Bible, holding that book responsible as if it originated certain facts on the shady side of human nature or the apparently darker lines of Providential dealing, though the facts are facts of common observation and have to be confronted upon any theory.

The "North American" reviewer also has a world of his own, — just such a one as an idealizing philosopher would be apt to devise, — that is, full of sharp and absolute distinctions: such, for instance, as the "absolute invariableness of instinct;" an absolute want of intelligence in any brute animal; and a complete monopoly of instinct by the brute animals, so that this "instinct is a great matter" for them only, since it sharply and perfectly distinguishes this portion of organic Nature from the vegetable kingdom on the one hand and from man on the other: most convenient views for argumentative purposes, but we suppose not borne out in fact.

In their scientific objections the two reviewers take somewhat different lines; but their philosophical and theological arguments strikingly coincide. They agree in emphatically asserting that Darwin's hypothesis of the origination of species through variation and natural selection "repudiates the whole doctrine of final causes," and "all indication of design or purpose in the organic world," — "is neither more

nor less than a formal denial of any agency beyond that of a blind chance in the developing or perfecting of the organs or instincts of created beings." "It is in vain that the apologists of this hypothesis might say that it merely attributes a different mode and time to the Divine agency, — that all the qualities subsequently appearing in their descendants must have been implanted, and remained latent in the original pair." Such a view, the Examiner declares, "is nowhere stated in this book, and would be, we are sure, disclaimed by the author." We should like to be informed of the grounds of this sureness. The marked rejection of spontaneous generation, — the statement of a belief that all animals have descended from four or five progenitors, and plants from an equal or lesser number, or, perhaps, if constrained to it by analogy, "from some one primordial form into which life was first breathed," — coupled with the expression, "To my mind it accords better with what we know of the laws impressed on matter by the Creator, that the production and extinction of the past and present inhabitants of the world should have been due to secondary causes," than "that each species has been independently created," — these and similar expressions lead us to suppose that the author probably does accept the kind of view which the "Examiner" is sure he would disclaim. At least, we charitably see nothing in his scientific theory to hinder his adoption of Lord Bacon's Confession of Faith in this regard, —

"That, notwithstanding God hath rested and ceased from creating, [in the sense of supernatural origination,] yet, nevertheless, He doth accomplish and fulfil His divine will in all things, great and small, singular and general, as fully and exactly by providence as He could by miracle and new creation, though His working be not immediate and direct, but by compass; not violating Nature, which is His own law upon the creature."

However that may be, it is undeniable that Mr. Darwin has purposely been silent upon the philosophical and theological applications of his theory. This reticence, under the circumstances, argues design, and raises inquiry as to the final cause or reason why. Here, as in higher instances, confident as we are that there is a final cause, we must not be over-confident that we can infer the particular or true one. Perhaps the author is more familiar with natural-historical than with philosophical inquiries, and, not having decided which particular theory about efficient cause is best founded, he meanwhile argues the scientific questions concerned — all that relates to secondary causes — upon purely scientific grounds, as he must do in any case. Perhaps, confident, as he evidently is, that his view will finally be adopted, he may enjoy a sort of satisfaction in hearing it denounced as sheer atheism by the inconsiderate, and afterwards, when it takes its place with the neb-

ular hypothesis and the like, see this judgment reversed, as we suppose it would be in such event.

Whatever Mr. Darwin's philosophy may be, or whether he has any, is a matter of no consequence at all, compared with the important questions, whether a theory to account for the origination and diversification of animal and vegetable forms through the operation of secondary causes does or does not exclude design; and whether the establishment by adequate evidence of Darwin's particular theory of diversification through variation and natural selection would essentially alter the present scientific and philosophical grounds for theistic views of Nature. The unqualified affirmative judgment rendered by the two Boston reviewers, evidently able and practised reasoners, "must give us pause." We hesitate to advance our conclusions in opposition to theirs. But, after full and serious consideration, we are constrained to say, that, in our opinion, the adoption of a derivative hypothesis, and of Darwin's particular hypothesis, if we understand it, would leave the doctrines of final causes, utility, and special design just where they were before. We do not pretend that the subject is not environed with difficulties. Every view is so environed; and every shifting of the view is likely, if it removes some difficulties, to bring others into prominence. But we cannot perceive that Darwin's theory brings in any new kind of scientific difficulty, that is, any with which philosophical naturalists were not already familiar.

Since natural science deals only with secondary or natural causes, the scientific terms of a theory of derivation of species — no less than of a theory of dynamics — must needs be the same to the theist as to the atheist. The difference appears only when the inquiry is carried up to the question of primary cause, — a question which belongs to philosophy. Wherefore, Darwin's reticence about efficient cause does not disturb us. He considers only the scientific questions. As already stated, we think that a theistic view of Nature is implied in his book, and we must charitably refrain from suggesting the contrary until the contrary is logically deduced from his premises. If, however, he anywhere maintains that the natural causes through which species are diversified operate without an ordaining and directing intelligence, and that the orderly arrangements and admirable adaptations we see all around us are fortuitous or blind, undesigned results, — that the eye, though it came to see, was not designed for seeing, nor the hand for handling, — then, we suppose, he is justly chargeable with denying, and very needlessly denying, all design in organic Nature; otherwise, we suppose not. Why, if Darwin's well-known passage about the eye *

* Page 188, English ed.

— equivocal or unfortunate though some of the language be — does not imply ordaining and directing intelligence, then he refutes his own theory as effectually as any of his opponents are likely to do. He asks, —

"May we not believe that [under variation proceeding long enough, generation multiplying the better variations times enough, and natural selection securing the improvements] a living optical instrument might be thus formed as superior to one of glass as the works of the Creator are to those of man?"

This must mean one of two things: either that the living instrument was made and perfected under (which is the same thing as by) an intelligent First Cause, or that it was not. If it was, then theism is asserted; and as to the mode of operation, how do we know, and why must we believe, that, fitting precedent forms being in existence, a living instrument (so different from a lifeless manufacture) would be originated and perfected in any other way, or that this is not the fitting way? If it means that it was not, if he so misuses words that by the Creator he intends an unintelligent power, undirected force, or necessity, then he has put his case so as to invite disbelief in it. For then blind forces have produced not only manifest adaptations of means to specific ends, — which is absurd enough — but better adjusted and more perfect instruments or machines than intellect (that is, human intellect) can contrive and human skill execute, — which no sane person will believe.

On the other hand, if Darwin even admits — we will not say adopts — the theistic view, he may save himself much needless trouble in the endeavor to account for the absence of every sort of intermediate form. Those in the line between one species and another supposed to be derived from it he may be bound to provide; but as to "an infinite number of other varieties not intermediate, gross, rude, and purposeless, the unmeaning creations of an unconscious cause," born only to perish, which a relentless reviewer has imposed upon his theory, — rightly enough upon the atheistic alternative, — the theistic view rids him at once of this "scum of creation." For, as species do not now vary at all times and places and in all directions, nor produce crude, vague, imperfect, and useless forms, there is no reason for supposing that they ever did. Good-for-nothing monstrosities, failures of purpose rather than purposeless, indeed sometimes occur; but these are just as anomalous and unlikely upon Darwin's theory as upon any other. For his particular theory is based, and even over-strictly insists, upon the most universal of physiological laws, namely, that successive generations shall differ only slightly, if at all, from their parents; and this effectively excludes crude and impotent forms. Wherefore, if we believe

that the species were designed, and that natural propagation was designed, how can we say that the actual varieties of the species were not equally designed? Have we not similar grounds for inferring design in the supposed varieties of a species, that we have in the case of the supposed species of a genus? When a naturalist comes to regard as three closely related species what he before took to be so many varieties of one species, how has he thereby strengthened our conviction that the three forms were designed to have the differences which they actually exhibit? Wherefore, so long as gradationed, orderly, and adapted forms in Nature argue design, and at least while the physical cause of variation is utterly unknown and mysterious, we should advise Mr. Darwin to assume, in the philosophy of his hypothesis, that variation has been led along certain beneficial lines. Streams flowing over a sloping plain by gravitation (here the counterpart of natural selection) may have worn their actual channels as they flowed; yet their particular courses may have been assigned; and where we see them forming definite and useful lines of irrigation, after a manner unaccountable on the laws of gravitation and dynamics, we should believe that the distribution was designed.

To insist, therefore, that the new hypothesis of the derivative origin of the actual species is incompatible with final causes and design, is to take a position which we must consider philosophically untenable. We must also regard it as highly unwise and dangerous, in the present state and present prospects of physical and physiological science. We should expect the philosophical atheist or sceptic to take this ground; also, until better informed, the unlearned and unphilosophical believer; but we should think that the thoughtful theistic philosopher would take the other side. Not to do so seems to concede that only supernatural events can be shown to be designed, which no theist can admit, — seems also to misconceive the scope and meaning of all ordinary arguments for design in Nature. This misconception is shared both by the reviewers and the reviewed. At least, Mr. Darwin uses expressions which imply that the natural forms which surround us, because they have a history or natural sequence, could have been only generally, but not particularly designed, — a view at once superficial and contradictory; whereas his true line should be, that his hypothesis concerns the *order* and not the *cause*, the *how* and not the *why* of the phenomena, and so leaves the question of design just where it was before.

To illustrate this from the theist's point of view. Transfer the question for a moment from the origination of species to the origination of individuals, which occurs, as we say, naturally. Because natural, that is, "stated, fixed, or settled," is it any the less designed on that account? We acknowledge that God is our maker, — not merely the originator

of the race, but *our* maker as individuals, — and none the less so because it pleased Him to make us in the way of ordinary generation. If any of us were born unlike our parents and grandparents, in a slight degree, or in whatever degree, would the case be altered in this regard?

The whole argument in natural theology proceeds upon the ground that the inference for a final cause of the structure of the hand and of the valves in the veins is just as valid now, in individuals produced through natural generation, as it would have been in the case of the first man, supernaturally created. Why not, then, just as good even on the supposition of the descent of men from Chimpanzees and Gorillas, since those animals possess these same contrivances? Or, to take a more supposable case: If the argument from structure to design is convincing when drawn from a particular animal, say a Newfoundland dog, and is not weakened by the knowledge that this dog came from similar parents, would it be at all weakened if, in tracing his genealogy, it were ascertained that he was a remote descendant of the mastiff or some other breed, or that both these and other breeds came (as is suspected) from some wolf? If not, how is the argument for design in the structure of our particular dog affected by the supposition that his wolfish progenitor came from a post-tertiary wolf, perhaps less unlike an existing one than the dog in question is to some other of the numerous existing races of dogs, and that this post-tertiary came from an equally or more different tertiary wolf? And if the argument from structure to design is not invalidated by our present knowledge that our individual dog was developed from a single organic cell, how is it invalidated by the supposition of an analogous natural descent, through a long line of connected forms, from such a cell, or from some simple animal, existing ages before there were any dogs?

Again, suppose we have two well-known and apparently most decidedly different animals or plants, A and D, both presenting, in their structure and in their adaptations to the conditions of existence, as valid and clear evidence of design as any animal or plant ever presented: suppose we have now discovered two intermediate species, B and C, which make up a series with equable differences from A to D. Is the proof of design or final cause in A and D, whatever it amounted to, at all weakened by the discovery of the intermediate forms? Rather does not the proof extend to the intermediate species, and go to show that all four were equally designed? Suppose, now, the number of intermediate forms to be much increased, and therefore the gradations to be closer yet, — as close as those between the various sorts of dogs, or races of men, or of horned cattle: would the evidence of design, as shown in the structure of any of the members of the series, be any

weaker than it was in the case of A and D? Whoever contends that it would be, should likewise maintain that the origination of individuals by generation is incompatible with design, and so take a consistent atheistical view of Nature. Perhaps we might all have confidently thought so, antecedently to experience of the fact of reproduction. Let our experience teach us wisdom.

These illustrations make it clear that the evidence of design from structure and adaptation is furnished *complete* by the individual animal or plant itself, and that our knowledge or our ignorance of the history of its formation or mode of production adds nothing to it and takes nothing away. We infer design from certain arrangements and results; and we have no other way of ascertaining it. Testimony, unless infallible, cannot prove it, and is out of the question here. *Testimony is not the appropriate proof of design: adaptation to purpose is.* Some arrangements in nature appear to be contrivances, but may leave us in doubt. Many others, of which the eye and the hand are notable examples, compel belief with a force not appreciably short of demonstration. Clearly to settle that such as these must have been designed goes far towards proving that other organs and other seemingly less explicit adaptations in Nature must also have been designed, and clinches our belief, from manifold considerations, that all Nature is a preconcerted arrangement, a manifested design. A strange contradiction would it be to insist that the shape and markings of certain rude pieces of flint, lately found in drift deposits, prove design, but that nicer and thousandfold more complex adaptations to use in animals and vegetables do not *a fortiori* argue design.

We could not affirm that the arguments for design in Nature are conclusive to all minds. But we may insist, upon grounds already intimated, that whatever they were good for before Darwin's book appeared, they are good for now. To our minds the argument from design always appeared conclusive of the being and continued operation of an intelligent First Cause, the Ordainer of Nature; and we do not see that the grounds of such belief would be disturbed or shifted by the adoption of Darwin's hypothesis. We are not blind to the philosophical difficulties which the thorough-going implication of design in Nature has to encounter, nor is it our vocation to obviate them. It suffices us to know that they are not new nor peculiar difficulties, — that, as Darwin's theory and our reasonings upon it did not raise these perturbing spirits, they are not bound to lay them. Meanwhile, that the doctrine of design encounters the very same difficulties in the material that it does in the moral world is just what ought to be expected.

So the issue between the sceptic and the theist is only the old one, long ago argued out, — namely, whether organic Nature is a result of

design or of chance. Variation and natural selection open no third alternative; they concern only the question how the results, whether fortuitous or designed, may have been brought about. Organic Nature abounds with unmistakable and irresistible indications of design, and, being a connected and consistent system, this evidence carries the implication of design throughout the whole. On the other hand, chance carries no probabilities with it, can never be developed into a consistent system; but when applied to the explanation of orderly or beneficial results, heaps up improbabilities at every step beyond all computation. To us, a fortuitous Cosmos is simply inconceivable. The alternative is a designed Cosmos.

It is very easy to assume, that, because events in Nature are in one sense accidental, and the operative forces which bring them to pass are themselves blind and unintelligent, (physically considered, all forces are,) therefore they are undirected, or that he who describes these events as the results of such forces thereby assumes that they are undirected. This is the assumption of the Boston reviewers, and of Mr. Agassiz, who insists that the only alternative to the doctrine, that all organized beings were supernaturally created just as they are, is, that they have arisen *spontaneously* through the *omnipotence of matter*.*

As to all this, nothing is easier than to bring out in the conclusion what you introduce in the premises. If you import atheism into your conception of variation and natural selection, you can readily exhibit it in the result. If you do not put it in, perhaps there need be none to come out. While the mechanician is considering a steamboat or locomotive engine as a material organism, and contemplating the fuel, water, and steam, the source of the mechanical forces, and how they operate, he may not have occasion to mention the engineer. But the orderly and special results accomplished, the *why* the movements are in this or that particular direction, etc., are inexplicable without him. If Mr. Darwin believes that the events which he supposes to have occurred and the results we behold were undirected and undesigned, or if the physicist believes that the natural forces to which he refers phenomena are uncaused and undirected, no argument is needed to show that such belief is atheism. But the admission of the phenomena and of these natural processes and forces does not necessitate any such belief, nor even render it one whit less improbable than before.

Surely, too, the accidental element may play its part in Nature without negativing design in the theist's view. He believes that the earth's surface has been very gradually prepared for man and the existing animal races, that vegetable matter has through a long series of generations

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* In *American Journal of Science*, July, 1860, pp. 147 - 149.

imparted fertility to the soil in order that it may support its present occupants, that even beds of coal have been stored up for man's benefit. Yet what is more accidental, and more simply the consequence of physical agencies, than the accumulation of vegetable matter in a peat-bog, and its transformation into coal? No scientific person at this day doubts that our solar system is a progressive development, whether in his conception he begins with molten masses, or aeriform or nebulous masses, or with a fluid revolving mass of vast extent, from which the specific existing worlds have been developed one by one. What theist doubts that the actual results of the development in the inorganic worlds are not merely compatible with design, but are in the truest sense designed results? Not Mr. Agassiz, certainly, who adopts a remarkable illustration of design directly founded on the nebular hypothesis, drawing from the position and times of revolution of the world so originated, "direct evidence that the physical world has been ordained in conformity with laws which obtain also among living beings." But the reader of the interesting exposition* will notice that the designed result has been brought to pass through what, speaking after the manner of men, might be called a chapter of accidents.

A natural corollary of this demonstration would seem to be, that a material connection between a series of created things — such as the development of one of them from another, or of all from a common stock — is highly compatible with their intellectual connection, namely, with their being designed and directed by one mind. Yet upon some ground which is not explained, and which we are unable to conjecture, Mr. Agassiz concludes to the contrary in the organic kingdoms, and insists, that, *because* the members of such a series have an intellectual connection, "they cannot be the result of a material differentiation of the objects themselves,"† that is, they cannot have had a genealogical connection. But is there not as much intellectual connection between the successive generations of any species as there is between the several species of a genus or the several genera of an order? As the intellectual connection here is realized through the material connection, why may it not be so in the case of species and genera? On all sides, therefore, the implication seems to be quite the other way.

Returning to the accidental element, it is evident that the strongest point against the compatibility of Darwin's hypothesis with design in Nature is made when natural selection is referred to as picking out those variations which are improvements from a vast number which

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* In *Contributions to the Nat. Hist. of U. S.*, Vol. I. pp. 128, 129.

† *Contr. Nat. Hist. U. S.*, Vol. I. p. 130; and *Amer. Journal of Science*, July, 1860, p. 143.

are not improvements, but perhaps the contrary, and therefore useless or purposeless, and born to perish. But even here the difficulty is not peculiar; for Nature abounds with analogous instances. Some of our race are useless, or worse, as regards the improvement of mankind; yet the race may be designed to improve, and may be actually improving. Or, to avoid the complication with free agency, — the whole animate life of a country depends absolutely upon the vegetation, the vegetation upon the rain. The moisture is furnished by the ocean, is raised by the sun's heat from the ocean's surface, and is wafted inland by the winds. But what multitudes of rain-drops fall back into the ocean, — are as much without a final cause as the incipient varieties which come to nothing! Does it therefore follow that the rains which are bestowed upon the soil with such rule and average regularity were not designed to support vegetable and animal life? Consider, likewise, the vast proportion of seeds and pollen, of ova and young, — a thousand or more to one, — which come to nothing, and are therefore purposeless in the same sense, and only in the same sense, as are Darwin's unimproved and unused slight variations. The world is full of such cases; and these must answer the argument, — for we cannot, except by thus showing that it proves too much.

Finally, it is worth noticing, that, though natural selection is scientifically explicable, variation is not. Thus far the cause of variation, or the reason why the offspring is sometimes unlike the parents, is just as mysterious as the reason why it is generally like the parents. It is now as inexplicable as any other origination; and if ever explained, the explanation will only carry up the sequence of secondary causes one step farther, and bring us in face of a somewhat different problem, but which will have the same element of mystery that the problem of variation has now. Circumstances may preserve or may destroy the variations; man may use or direct them; but selection, whether artificial or natural, no more originates them than man originates the power which turns a wheel, when he dams a stream and lets the water fall upon it. The origination of this power is a question about efficient cause. The tendency of science in respect to this obviously is not towards the omnipotence of matter, as some suppose, but towards the omnipotence of spirit.

So the real question we come to is as to the way in which we are to conceive intelligent and efficient cause to be exerted, and upon what exerted. Are we bound to suppose efficient cause in all cases exerted upon nothing to evoke something into existence, — and this thousands of times repeated, when a slight change in the details would make all the difference between successive species? Why may not the new species, or some of them, be designed diversifications of the old?

There are, perhaps, only three views of efficient cause which may claim to be both philosophical and theistic.

1. The view of its exertion at the beginning of time, endowing matter and created things with forces which do the work and produce the phenomena.

2. This same view, with the theory of insulated interpositions, or occasional direct action, engrafted upon it, — the view that events and operations in general go on in virtue simply of forces communicated at the first, but that now and then, and only now and then, the Deity puts his hand directly to the work.

3. The theory of the immediate, orderly, and constant, however infinitely diversified, action of the intelligent efficient Cause.

It must be allowed, that, while the third is pre-eminently the Christian view, all three are philosophically compatible with design in Nature. The second is probably the popular conception. Perhaps most thoughtful people oscillate from the middle view towards the first or the third, — adopting the first on some occasions, the third on others. Those philosophers who like and expect to settle all mooted questions will take one or the other extreme. The "Examiner" inclines towards, the "North American" reviewer fully adopts, the third view, to the logical extent of maintaining that "*the origin of an individual*, as well as the origin of a species or a genus, can be explained only by the *direct* action of an intelligent creative cause." To silence his critics, this is the line for Mr. Darwin to take; for it at once and completely relieves his scientific theory from every theological objection which his reviewers have urged against it.

At present we suspect that our author prefers the first conception, though he might contend that his hypothesis is compatible with either of the three. That it is also compatible with an atheistic or pantheistic conception of the universe, is an objection which, being shared by all physical, and some ethical or moral science, cannot specially be urged against Darwin's system. As he rejects spontaneous generation, and admits of intervention at the beginning of organic life, and probably in more than one instance, he is not wholly excluded from adopting the middle view, although the interventions he would allow are few and far back. Yet one interposition admits the principle as well as more. Interposition presupposes particular necessity or reason for it, and raises the question, when and how often it may have been necessary. It would be the natural supposition, if we had only one set of species to account for, or if the successive inhabitants of the earth had no other connections or resemblances than those which adaptation to similar conditions, which final causes in the narrower sense, might explain. But if this explanation of organic Nature requires one to "believe that,

at innumerable periods in the earth's history, certain elemental atoms have been commanded suddenly to flash into living tissues," and this when the results are seen to be strictly connected and systematic, we cannot wonder that such interventions should at length be considered, not as interpositions or interferences, but rather — to use the reviewers' own language — as "exertions so frequent and beneficent that we come to regard them as the ordinary action of Him who laid the foundation of the earth, and without whom not a sparrow falleth to the ground." *

What does the difference between Mr. Darwin and his reviewer now amount to? If we say that according to one view the origination of species is *natural*, according to the other *miraculous*, Mr. Darwin agrees that "what is natural as much requires and presupposes an intelligent mind to render it so, — that is, to effect it continually or at stated times, — as what is supernatural does to effect it for once." † He merely inquires into the form of the miracle, may remind us that all recorded miracles (except the primal creation of matter) were transformations or actions in and upon natural things, and will ask how many times and how frequently may the origination of successive species be repeated before the supernatural merges in the natural.

In short, Darwin maintains that the origination of a species, no less than that of an individual, is natural. The reviewer, that the natural origination of an individual, no less than the origination of a species, requires and presupposes Divine power. *A fortiori*, then, the origination of a variety requires and presupposes Divine power. And so between the scientific hypothesis of the one and the philosophical conception of the other no contrariety remains. And so, concludes the "North American" reviewer, "a proper view of the nature of causation . . . . places the vital doctrine of the being and the providence of a God on ground that can never be shaken." ‡ A worthy conclusion, and a sufficient answer to the denunciations and arguments of the rest of the article, so far as philosophy and natural theology are concerned. If a writer must needs use his own favorite dogma as a weapon with which to give *coup de grace* to a pernicious theory, he should be careful to seize it by the handle, and not by the blade.

We can barely glance at a subsidiary philosophical objection of the "North American" reviewer, which the "Examiner" also raises, though less explicitly. Like all geologists, Mr. Darwin draws upon time in the most unlimited manner. He is not peculiar in this regard.

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* *North American Review*, for April, 1860, p. 506.

† *Vide* motto from Butler, prefixed to the second edition of Darwin's work.

‡ *North American Review*, l. c. p. 504.

Mr. Agassiz tells us that the conviction is "now universal among well-informed naturalists, that this globe has been in existence for innumerable ages, and that the length of time elapsed since it first became inhabited cannot be counted in years." Pictet, that the imagination refuses to calculate the immense number of years and of ages during which the faunas of thirty or more epochs have succeeded one another, and developed their long succession of generations. Now the reviewer declares that such indefinite succession of ages is "virtually infinite," "lacks no characteristic of eternity except its name," — at least, that "the difference between such a conception and that of the strictly infinite, if any, is not appreciable." But infinity belongs to metaphysics. Therefore, he concludes, Darwin supports his theory, not by scientific, but by metaphysical evidence; his theory is "essentially and completely metaphysical in character, resting altogether upon that idea of 'the infinite' which the human mind can neither put aside nor comprehend." * And so a theory which will be generally regarded as much too physical is transferred by a single syllogism to metaphysics.

Well, physical geology must go with it: for, even on the soberest view, it demands an indefinitely long time antecedent to the introduction of organic life upon our earth. *A fortiori* is physical astronomy a branch of metaphysics, demanding, as it does, still larger "instalments of infinity," as the reviewer calls them, both as to time and number. Moreover, far the greater part of physical inquiries now relate to molecular actions, which, a distinguished natural philosopher informs us, "we have to regard as the results of an *infinite* number of *infinitely* small material particles, acting on each other at *infinitely* small distances," — a triad of infinites, — and so *physics* becomes the most *metaphysical* of sciences. Verily, if this style of reasoning is to prevail,

> "Thinking is but an idle waste of thought,
> And naught is everything, and everything is naught."

The leading objection of Mr. Agassiz is likewise of a philosophical character. It is, that species exist only "as categories of thought," — that, having no material existence, they can have had no material variation, and no material community of origin. Here the predication is of species in the subjective sense, the inference in the objective sense. Reduced to plain terms, the argument seems to be: Species are ideas; therefore the objects from which the idea is derived cannot vary or blend, and cannot have had a genealogical connection.

The common view of species is, that, although they are generalizations, yet they have a direct objective ground in Nature, which genera,

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* *North American Review*, l. c. p. 487, *et passim*.

orders, etc. have not. According to the succinct definition of Jussieu, — and that of Linnæus is identical in meaning, — a species is the perennial succession of similar individuals in continued generations. The species is the chain of which the individuals are the links. The sum of the genealogically connected similar individuals constitutes the species, which thus has an actuality and ground of distinction not shared by genera and other groups which were not supposed to be genealogically connected. How a derivative hypothesis would modify this view, in assigning to species only a temporary fixity, is obvious. Yet, if naturalists adopt that hypothesis, they will still retain Jussieu's definition, which leaves untouched the question as to how and when the "perennial successions" were established. The practical question will only be, How much difference between two sets of individuals entitles them to rank under distinct species; and that is the practical question now, on whatever theory. The theoretical question is — as stated at the beginning of this article — whether these specific lines were always as distinct as now.

Mr. Agassiz has "lost no opportunity of urging the idea, that, while species have no material existence, they yet exist as categories of thought in the same way [and only in the same way] as genera, families, orders, classes," etc. He

"has taken the ground, that all the natural divisions in the animal kingdom are primarily distinct, founded upon different categories of characters, and that all exist in the same way, that is, as categories of thought, embodied in individual living forms. I have attempted to show that branches in the animal kingdom are founded upon different plans of structure, and for that very reason have embraced from the beginning representatives between which there could be no community of origin; that classes are founded upon different modes of execution of these plans, and therefore they also embrace representatives which could have no community of origin; that orders represent the different degrees of complication in the mode of execution of each class, and therefore embrace representatives which could not have a community of origin any more than the members of different classes or branches; that families are founded upon different patterns of form, and embrace representatives equally independent in their origin; that genera are founded upon ultimate peculiarities of structure, embracing representatives which, from the very nature of their peculiarities, could have no community of origin; and that, finally, species are based upon relations and proportions that exclude, as much as all the preceding distinctions, the idea of a common descent.

"As the community of characters among the beings belonging to these different categories arises from the intellectual connection which shows them to be categories of thought, they cannot be the result of a gradual material differentiation of the objects themselves. The argument on which these views are founded may be summed up in the following few words: Species, genera, families, etc. exist as thoughts, individuals as facts."*

An ingenious dilemma caps the argument: —

* In *American Journal of Science*, July, 1860, p. 143.

"It seems to me that there is much confusion of ideas in the general statement of the variability of species so often repeated lately. If species do not exist at all, as the supporters of the transmutation theory maintain, how can they vary? and if individuals alone exist, how can the differences which may be observed among them prove the variability of species?"

Now we imagine that Mr. Darwin need not be dangerously gored by either horn of this curious dilemma. Although we ourselves cherish old-fashioned prejudices in favor of the probable permanence, and therefore of a more stable objective ground of species, yet we agree — and Mr. Darwin will agree fully with Mr. Agassiz — that species, and he will add varieties, "exist as categories of thought," that is, as cognizable distinctions, — which is all that we can make of the phrase here, whatever it may mean in the Aristotelian metaphysics. Admitting that species are only categories of thought, and not facts or things, how does this prevent the individuals, which are material things, from having varied in the course of time, so as to exemplify the present almost innumerable categories of thought, or embodiments of Divine thought in material forms, or — viewed on the human side — in forms marked with such orderly and graduated resemblances and differences as to suggest to our minds the idea of species, genera, orders, etc., and to our reason the inference of a Divine Original? We have no clear idea how Mr. Agassiz intends to answer this question, in saying that branches are founded upon different plans of structure, classes upon different modes of execution of these plans, orders on different degrees of complication in the mode of execution, families upon different patterns of form, genera upon ultimate peculiarities of structure, and species upon relations and proportions. That is, we do not perceive how these several "categories of thought" exclude the possibility or the probability that the individuals which manifest or suggest the thoughts had an ultimate community of origin.

Moreover, Mr. Darwin might insinuate that the particular philosophy of classification upon which this whole argument reposes is as purely hypothetical and as little accepted as is his own doctrine. If both are pure hypotheses, it is hardly fair or satisfactory to extinguish the one by the other. If there is no real contradiction between them, nothing is gained by the attempt.

As to the dilemma propounded, suppose we try it upon that category of thought which we call *chair*. This is a genus, comprising the common chair (*Sella vulgaris*), the arm or easy chair (*S. cathedra*), the rocking-chair (*S. oscillans*), — widely distributed in the United States, — and some others, each of which has *sported*, as the gardeners say, into many varieties. But now, as the *genus* and the *species* have no material existence, how can they vary? If individuals alone exist, how

can the differences which may be observed among them prove the variability of the species? To which we reply by asking, Which does the question refer to, the category of thought, or the individual embodiment? If the former, then we would remark that our categories of thought vary from time to time in the readiest manner. And, although the Divine thoughts are eternal, yet they are manifested to us in time and succession, and by their manifestation only can we know them, how imperfectly! Allowing that what has no material existence can have had no material connection or variation, we should yet infer that what has intellectual existence and connection might have intellectual variation; and, turning to the individuals, which represent the species, we do not see how all this shows that they may not vary. Observation shows us that they do. Wherefore, taught by fact that successive individuals do vary, we safely infer that the idea must have varied, and that this variation of the individual representatives proves the variability of the species, whether objectively or subjectively regarded.

Each species or sort of chair, as we have said, has its varieties, and one species shades off by gradations into another. And — note it well — these numerous and successively slight variations and gradations, far from suggesting an accidental origin to chairs and to their forms, are very proofs of design.

Again, *edifice* is a generic category of thought. Egyptian, Grecian, Byzantine, and Gothic buildings are well-marked species, of which each individual building of the sort is a material embodiment. Now the question is, whether these categories or ideas may not have been evolved, one from another in succession, or from some primal, less specialized, edificial category. What better evidence for such hypothesis could we have than the variations and grades which connect these species with each other? We might extend the parallel, and get some good illustrations of natural selection from the history of architecture, and the origin of the different styles under different climates and conditions. Two considerations may qualify or limit the comparison. One, that houses do not propagate, so as to produce continuing lines of each sort and variety; but this is of small moment on Agassiz's view, he holding that genealogical connection is not of the essence of species at all. The other, that the formation and development of the ideas upon which human works proceed is gradual; or, as the same great naturalist well states it, "while human thought is consecutive, Divine thought is simultaneous." But we have no right to affirm this of Divine action.

We must close here. We meant to review some of the more general scientific objections which we thought not altogether tenable. But,

after all, we are not so anxious just now to know whether the new theory is well founded on facts, as whether it would be harmless if it were. Besides, we feel quite unable to answer some of these objections, and it is pleasanter to take up those which one thinks he can.

Among the unanswerable, perhaps the weightiest of the objections, is that of the absence, in geological deposits, of vestiges of the intermediate forms which the theory requires to have existed. Here all that Mr. Darwin can do is to insist upon the extreme imperfection of the geological record and the uncertainty of negative evidence. But, withal, he allows the force of the objection almost as much as his opponents urge it, — so much so, indeed, that two of his English critics turn the concession unfairly upon him, and charge him with actually basing his hypothesis upon these and similar difficulties, — as if he held it because of the difficulties, and not in spite of them; a handsome return for his candor!

As to this imperfection of the geological record, perhaps we should get a fair and intelligible illustration of it by imagining the existing animals and plants of New England, with all their remains and products since the arrival of the Mayflower, to be annihilated; and that, in the coming time, the geologists of a new colony, dropped by the New Zealand fleet on its way to explore the ruins of London, undertake, after fifty years of examination, to reconstruct in a catalogue the flora and fauna of our day, that is, from the close of the glacial period to the present time. With all the advantages of a surface exploration, what a beggarly account it would be! How many of the land animals and plants which are enumerated in the Massachusetts official reports would it be likely to contain?

Another unanswerable question asked by the Boston reviewers is, Why, when structure and instinct or habit vary, — as they must have varied, on Darwin's hypothesis, — they vary together and harmoniously, instead of vaguely? We cannot tell, because we cannot tell why either varies at all. Yet, as they both do vary in successive generations, — as is seen under domestication, — and are correlated, we can only adduce the fact. Darwin may be precluded from our answer, but we may say that they vary together because designed to do so. A reviewer says that the chance of their varying together is inconceivably small; yet if they do not, the variant individuals must all perish. Then it is well that it is not left to chance. To refer to a parallel case: before we were born, nourishment and the equivalent to respiration took place in a certain way. But the moment we were ushered into this breathing world, our actions promptly conformed, both as to respiration and nourishment, to the before unused structure and to the new surroundings.

"Now," says the Examiner, "suppose, for instance, the gills of an aquatic animal converted into lungs, while instinct still compelled a continuance under water, would not drowning ensue?" No doubt. But — simply contemplating the facts, instead of theorizing — we notice that young frogs do not keep their heads under water after ceasing to be tadpoles. The instinct promptly changes with the structure, without supernatural interposition, — just as Darwin would have it, if the development of a variety or incipient species, though rare, were as natural as a metamorphosis.

"Or if a quadruped, not yet furnished with wings, were suddenly inspired with the instinct of a bird, and precipitated itself from a cliff, would not the descent be hazardously rapid?" Doubtless the animal would be no better supported than the objection. But Darwin makes very little indeed of voluntary efforts as a cause of change, and even poor Lamarck need not be caricatured. He never supposed that an elephant would take such a notion into his wise head, or that a squirrel would begin with other than short and easy leaps; yet might not the length of the leap be increased by practice?

The "North American" reviewer's position, that the higher brute animals have comparatively little instinct and no intelligence, is a heavy blow and great discouragement to dogs, horses, elephants, and monkeys. Thus stripped of their all, and left to shift for themselves as they may in this hard world, their pursuit and seeming attainment of knowledge under such peculiar difficulties is interesting to contemplate. However, we are not so sure as is the critic that instinct regularly increases downward and decreases upward in the scale of being. Now that the case of the bee is reduced to moderate proportions,* we know of nothing in instinct surpassing that of an animal so high as a bird, the Talegal, the male of which plumes himself upon making a hot-bed in which to hatch his partner's eggs, — which he tends and regulates the heat of about as carefully and skilfully as the unplumed biped does an eccaleobion.†

As to the real intelligence of the higher brutes, it has been ably defended by a far more competent observer, Mr. Agassiz, to whose conclusions we yield a general assent, although we cannot quite place the best of dogs "in that respect upon a level with a considerable proportion of poor humanity," nor indulge the hope, or indeed the desire, of a renewed acquaintance with the whole animal kingdom in a future life.‡

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* *Vide* article by Mr. C. Wright, in the *Mathematical Monthly* for May last.

† Vide *Edinburgh Review* for January, 1860, article on "Acclimatization," etc.

‡ *Contributions*, *Essay on Classification*, etc., Vol. I. pp. 60 – 66.

The assertion, that acquired habitudes or instincts, and acquired structures, are not heritable, any breeder or good observer can refute.*

That "the human mind has become what it is out of a developed instinct," † is a statement which Mr. Darwin nowhere makes, and, we presume, would not accept.‡ That he would have us believe that in-

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* Still stronger assertions have recently been hazarded, — even that heritability is of species only, not of individual characteristics, — strangely overlooking the fundamental peculiarity of plants and animals, which is that they *reproduce*, and that the species is continued as such only because individuals reproduce their like. The former is a consequence of the latter, not an ultimate fact. As has elsewhere been stated: —

"The common proposition is, that *species reproduce their like;* this is a sort of general inference, only a degree closer to fact than the statement that genera reproduce their like. The true proposition, the fact incapable of further analysis, is, that *individuals reproduce their like*, — that characteristics are inheritable. So varieties, or deviations once originated, [and apparently they almost everywhere tend to originate.] are perpetuable, like species. Not so likely to be perpetuated at the outset; for the new form tends to resemble a grandparent and a long line of similar ancestors, as well as to resemble its immediate progenitors. Two forces which coincide in the ordinary case, where the offspring resembles its parent, act in different directions when it does not, and it is uncertain which will prevail. If the remoter, but very potent ancestral influence predominates, the variation disappears with the life of the individual. If that of the immediate parent, — feebler no doubt, but closer, — the variety survives in the offspring; whose progeny now has a redoubled tendency to produce its own like; whose progeny again is almost sure to produce its like, since it is much the same whether it takes after its mother or its grandmother.

"In this way races arise, which under favorable conditions may be as hereditary as species. In following these indications, watching opportunities, and breeding only from those individuals which vary most in a desirable direction, man leads the course of variation as he leads a streamlet, — apparently at will, but never against the force of gravitation, — to a long distance from its source, and makes it more subservient to his use or fancy. . . . . .

"Why varieties develop so readily and deviate so widely under domestication, while they are apparently so rare or so transient in free nature, may easily be shown. In nature, even with hermaphrodite plants, there is a vast amount of cross fertilization among various individuals of the same species. The inevitable result of this is to repress variation, to keep the mass of a species comparatively homogeneous over any area in which it abounds in individuals. . . . . .

"In domestication, this intercrossing may be prevented; and in this prevention lies the art of producing varieties. But 'the art itself is Nature,' since the whole art consists in allowing the most universal of all natural tendencies in organic things (inheritability) to operate uncontrolled by other and obviously incidental tendencies." — *American Journal of Science and Arts*, for March, 1860.

It has also been urged that variation is never cumulative. If this means that varieties are not capable of further variation, it is not borne out by observation. For cultivators and breeders well know that the main difficulty is to initiate a variation, and that new varieties are particularly prone to vary more.

† *North American Review*, April, 1860, p. 475.

‡ No doubt he would equally distinguish in kind between *instinct* (which physiologically is best conceived of as *congenital habit*, so that habits when inherited become instincts, just as varieties become fixed into races) and intelligence, but would maintain that both are endowments of the higher brutes and of man, however vastly unequal their degree, and with whatever superaddition to simple intelligence in the latter.

dividual animals acquire their instincts gradually,* is a statement which must have been penned in inadvertence both of the very definition of instinct, and of everything we know of in Mr. Darwin's book.

It has been attempted to destroy the very foundation of Darwin's hypothesis by denying that there are any wild varieties, to speak of, for natural selection to operate upon. We cannot gravely sit down to prove that wild varieties abound. We should think it just as necessary to prove that snow falls in winter. That variation among plants cannot be largely due to hybridism, and that their variation in Nature is not essentially different from much that occurs in domestication, and, in the long run, probably hardly less in amount, we could show, if our space permitted.

As to the sterility of hybrids, that can no longer be insisted upon as absolutely true, nor be practically used as a test between species and varieties, unless we allow that hares and rabbits are of one species. That such sterility, whether total or partial, subserves a purpose in keeping species apart, and was so designed, we do not doubt. But the critics fail to perceive that this sterility proves nothing whatever against the derivative origin of the actual species; for it may as well have been intended to keep separate those forms which have reached a certain amount of divergence, as those which were always thus distinct.

The argument for the permanence of species, drawn from the identity with those now living of cats, birds, and other animals preserved in Egyptian catacombs, was good enough as used by Cuvier against St. Hilaire, that is, against the supposition that time brings about a gradual alteration of whole species; but it goes for little against Darwin, unless it be proved that species never vary, or that the perpetuation of a variety necessitates the extinction of the parent breed. For Darwin clearly maintains — what the facts warrant — that the mass of a species remains fixed so long as it exists at all, though it may set off a

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To allow that "brutes have certain mental endowments in common with men," . . . . . desires, affections, memory, simple imagination or the power of reproducing the sensible past in mental pictures, and even judgment of the simple or intuitive kind," — that "they compare and judge," (*Mem. Amer. Acad.* 8, p. 118,) — is to concede that the intellect of brutes really acts, so far as we know, like human intellect, as far as it goes; for the philosophical logicians tell us that all reasoning is reducible to a series of simple judgments. And Aristotle declares that even reminiscence — which is, we suppose, "reproducing the sensible past in mental pictures" — is a sort of reasoning (*τὸ ἀναμιμνήσκεσθαί ἐστιν οἷον συλλογισμός τις.*)

On the other hand, Mr. Darwin's expectation that "psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation," comes from a school of philosophy which we have no sympathy with.

* *American Journal of Science*, July, 1860, p. 146.

variety now and then. The variety may finally supersede the parent form, or it may coexist with it; yet it does not in the least hinder the unvaried stock from continuing true to the breed, unless it crosses with it. The common law of inheritance may be expected to keep both the original and the variety mainly true as long as they last, and none the less so because they have given rise to occasional varieties. The tailless Manx cats, like the curtailed fox in the fable, have not induced the normal breeds to dispense with their tails, nor have the Dorkings (apparently known to Pliny) affected the permanence of the common sort of fowl.

As to the objection, that the lower forms of life ought, on Darwin's theory, to have been long ago improved out of existence, and replaced by higher forms, the objectors forget what a vacuum that would leave below, and what a vast field there is to which a simple organization is best adapted, and where an advance would be no improvement, but the contrary. To accumulate the greatest amount of being upon a given space, and to provide as much enjoyment of life as can be under the conditions, is what Nature seems to aim at; and this is effected by diversification.

Finally, we advise nobody to accept Darwin's or any other derivative theory as true. The time has not come for that, and perhaps never will. We also advise against a similar credulity on the other side, in a blind faith that species — that the manifold sorts and forms of existing animals and vegetables — "have no secondary cause." The contrary is already not unlikely, and we suppose will hereafter become more and more probable. But we are confident, that, if a derivative hypothesis ever is established, it will be so on a solid theistic ground.

Meanwhile an inevitable and legitimate hypothesis is on trial, — an hypothesis thus far not untenable, — a trial just now very useful to science, and, we conclude, not harmful to religion, unless injudicious assailants temporarily make it so.

One good effect is already manifest: its enabling the advocates of the hypothesis of a multiplicity of human species to perceive the double insecurity of their ground. When the races of men are admitted to be of one *species*, the corollary, that they are of one *origin*, may be expected to follow. Those who allow them to be of one species must admit an actual diversification into strongly marked and persistent varieties, and so admit the basis of fact upon which the Darwinian hypothesis is built; while those, on the other hand, who recognize several or numerous human species, will hardly be able to maintain that such species were primordial and supernatural in the ordinary sense of the word.

The English mind is prone to positivism and kindred forms of materialistic philosophy, and we must expect the derivative theory to be taken up in that interest. We have no predilection for that school, but the contrary. If we had, we might have looked complacently upon a line of criticism which would indirectly, but effectively, play into the hands of positivists and materialistic atheists generally. The wiser and stronger ground to take is, that the derivative hypothesis leaves the argument for design, and therefore for a Designer, as valid as it ever was; — that to do any work by an instrument must require, and therefore presuppose, the exertion rather of more than of less power than to do it directly; — that whoever would be a consistent theist should believe that Design in the natural world is coextensive with Providence, and hold as firmly to the one as he does to the other, in spite of the wholly similar and apparently insuperable difficulties which the mind encounters whenever it endeavors to develop the idea into a complete system, either in the material and organic, or in the moral world. It is enough, in the way of obviating objections, to show that the philosophical difficulties of the one are the same, and only the same, as of the other.